NEXTEL

COMMERCIAL SERVICES ASSESSMENT

PUBLIC SAFETY
WIRELESS NETWORK (PSWN)
PROGRAM MANAGEMENT OFFICE

Fairfax, Virginia
July 10, 1998

BOOZ·ALLEN & HAMILTON

NEXTEL

COMMERCIAL SERVICES ASSESSMENT

PUBLIC SAFETY
WIRELESS NETWORK (PSWN)
PROGRAM MANAGEMENT OFFICE

Fairfax, Virginia
July 10, 1998

BOOZ·ALLEN & HAMILTON

Foreword...

PUBLIC SAFETY AGENCIES RELY HEAVILY ON THEIR PRIVATE LAND MOBILE RADIO (LMR) NETWORKS BUT ALSO USE COMMERCIAL WIRELESS SERVICES

- The expansion of commercial wireless service offerings provides an opportunity to examine these services as potential cost-effective alternatives or adjuncts to privately owned networks

- In support of the Public Safety Wireless Network (PSWN) Program Management Office (PMO), Booz•Allen & Hamilton analyzed Nextel commercial wireless services and assessed their current or future role in the public safety communications architecture
  - This report is not intended to reflect a government position or endorse the service
  - We invite comments to ensure the most current information is included in our analysis
  - If you have comments regarding the information contained in this document, please contact the PSWN PMO at 800-565-PSWN or access the PSWN Program Home Page at: www.pswn.gov

- Booz•Allen relied on several sources of information for the report
  - Industry literature
  - Interviews with Nextel and Motorola
  - Interviews with public safety representatives

I. INTRODUCTION

Introduction...

THE REPORT HIGHLIGHTS IMPORTANT ASPECTS OF NEXTEL, PARTICULARLY ITS SERVICES AND NETWORKS, AND PROVIDES AN ANALYSIS OF HOW THE PUBLIC SAFETY COMMUNITY IS CURRENTLY USING NEXTEL'S SERVICES TO PERFORM THEIR MISSION

- Section II provides an overview of Nextel and its services
  - Market position   -   Distribution
  - History   -   Availability
  - Service Offerings   -   Joint Ventures
  - Service Costs   -   Corporate Profile

- Section III provides an overview of Nextel's networks
  - Build-Out
  - Architecture
  - Reliability
  - Privacy
  - Advanced Features Not Deployed

- Section IV discusses the public safety communities use of Nextel services
  - What types of organizations are using Nextel
  - What missions are being supported
  - Observations/perceptions of Nextel

- Section V provides a summary and conclusions regarding Nextel and its use by public safety organizations

- Appendix A provides a detailed description of Nextel's network architecture
  - iDEN System Elements
  - Call processing

II. NEXTEL OVERVIEW

NEXTEL OFFERS ANALOG AND DIGITAL SPECIALIZED MOBILE RADIO (SMR) SERVICES

- SMR is a commercial, for-profit wireless service that primarily provides businesses with mobile dispatch communications
  - Dispatch communications are one-to-one or one-to-many messages
  - In 1974, the Federal Communications Commission (FCC) created SMR at the same time as cellular telephony
  - The first SMR system in the United States became operational in 1977
  - According to the Strategis Group, more than three million SMR subscribers exist in the United States, most of whom are part of the services, construction, and transportation industries

- Demand for more enhanced and bundled services and features such as paging, interconnection with the public switched telephone network (PSTN), and mobile data transmission has led to the development and deployment of more sophisticated digital SMR technology
  - Nextel is one of only a few large SMR operators rolling out wide-area systems using digital technology and multisite, cellular-like architectures
  - Nextel's digital network relies on a wide-area SMR technology referred to as Enhanced Specialized Mobile Radio (ESMR), which is based on Motorola's Integrated Dispatch Enhanced Network (iDEN) technology
  - Nextel's digital services are offered in the 800 MHz range only; it's analog services are offered in both the 800 and 900 MHz ranges

- By taking advantage of FCC rulings allowing SMR operators to assemble nationwide systems, Nextel is rapidly implementing a digital network that will be available nationwide and will allow the company to compete with cellular and personal communication services (PCS) operators

NEXTEL WAS FOUNDED IN 1987 UNDER THE ORIGINAL NAME OF FLEETCALL

- The company has grown significantly through the merger and acquisition of several SMR providers and other related assets

- The following is a list of several major acquisitions or mergers:
    - In July 1994, Nextel merged with OneComm, creating a company capable of providing service in all of the top 50 U.S. markets
    - In August 1994, Nextel merged with Questar Telecom Inc, acquiring ownership of SMR licenses in California and Nevada
    - In August 1994, Motorola acquired 22% of Nextel in exchange for its 800 MHz licenses and related businesses in the United States; the deal was worth $450 million
    - In February 1995, Nextel agreed to a tax-free stock merger with Dial Call, the leading SMR provider in the southeast United States, worth $650 million
    - In 1995, Nextel issued 4.2 million shares of common stock for all the remaining shares of American Mobile Systems (AMS)
    - In December 1996, Nextel acquired 6,000 800 MHz channels from Pittencrieff Communications Inc (PCI)

- In recent years, Nextel's management structure has undergone significant change and is committed to overhauling its network technology, reorganizing its operations and infrastructure, and introducing new product offerings
    - In April 1995, cellular pioneer Craig McCaw acquired approximately 26 percent of Nextel for a reported $1.1 billion and is an active Board of Directors member
    - In January 1996, Timothy Donahue, a former McCaw Cellular/ AT&T Wireless Services executive, became President and Chief Operating Officer of Nextel
    - One month later, Daniel Akerson, former president of MCI, joined as Nextel's Chief Executive Officer
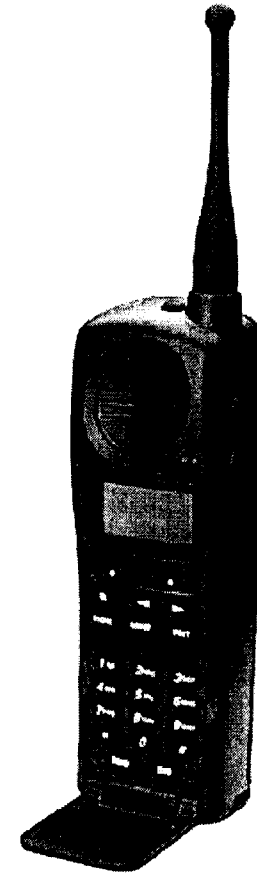
i600	r370	Lingo 3000

Features

| i600	r370	Lingo 3000
➢ Call Forwarding	➢ Call Forwarding	➢ Call forwarding
➢ Call Hold	➢ Call Hold	➢ Call Hold
➢ Call Waiting	➢ Call Waiting	➢ Incoming call alert
➢ Last Number redial	➢ Last Number redial	➢ Call waiting
➢ Scratchpad memory	➢ Scratchpad memory	➢ Last # redial
➢ Automatic redial	➢ Automatic redial	➢ Scratchpad memory
➢ Phone list stores 100 speed dial numbers	➢ Phone list stores 100 speed dial numbers	➢ 100 speed dial #s
➢ 3 call timers	➢ 3 call timers	➢ Call alert
➢ Call Alert	➢ Call Alert	➢ 99 Private Call Ids
➢ Private Call list stores 100 private ID #s	➢ Private Call list stores 100 private ID #s	➢ 30 preprogrammed talkgroups
➢ 50 preprogrammed talkgroups	➢ 30 preprogrammed talkgroups	➢ On-screen notification of new messages
➢ Icon and audio notification of new text message	➢ Icon and audio notification of new text message	➢ Stores 8 messages
➢ 140 characters text	➢ 140 characters text	➢ One-touch call back
➢ Stores up to 16 messages	➢ Stores up to 16 messages	➢ Military standards specs
➢ One-touch call back of phone numbers in text/numeric messages	➢ One-touch call back of phone numbers in text/numeric messages	
	➢ Military standard specs	

II-3F

NEXTEL DIFFERENTIATES ITSELF FROM OTHER COMMERCIAL WIRELESS SERVICES BY PROVIDING CELLULAR PHONE SERVICE, PRIVATE AND GROUP DISPATCH, AND ALPHANUMERIC TEXT MESSAGING THROUGH ONE HANDSET

- The company does not offer mobile data services but plans to within the next two years

- Users are responsible for purchasing or leasing end-user equipment, which are typically portable radios
  - Nextel does not offer a leasing option on end-user equipment, but leasing arrangements do exist through indirect dealers and agents
  - The facing page shows three samples phones—i600, r370, and Lingo 3000
  - The i600 is Nextel's smallest and feature-rich phone; it costs approximately $229
  - The r370 is a compact but rugged phone manufactured to meet Military Standard 810 C/D/E environmental specifications; the phone is priced by Nextel at $349
  - The Lingo 3000 is a larger handset compared to the i600 or r370 and costs $629

- A wide variety of radios and accessories are available through Nextel or other wireless services dealers
  - Handsfree car kit
  - NiCd, NiMH, Li-ION batteries
  - Remote speaker microphone
  - Desktop and vehicle chargers
  - Handsfree earpiece kit
  - Various leather and nylon cases
  - Data and VBC cable

- Motorola and competing manufacturers who are licensed by Motorola will be the only manufacturers of subscriber equipment that is compatible with Nextel's digital network
  - Motorola has agreed to license at least one alternative manufacturer of iDEN infrastructure equipment
  - Currently, however, no arrangements exist with any additional manufacturers to supply Nextel with an alternative source for either iDEN system infrastructure or subscriber equipment
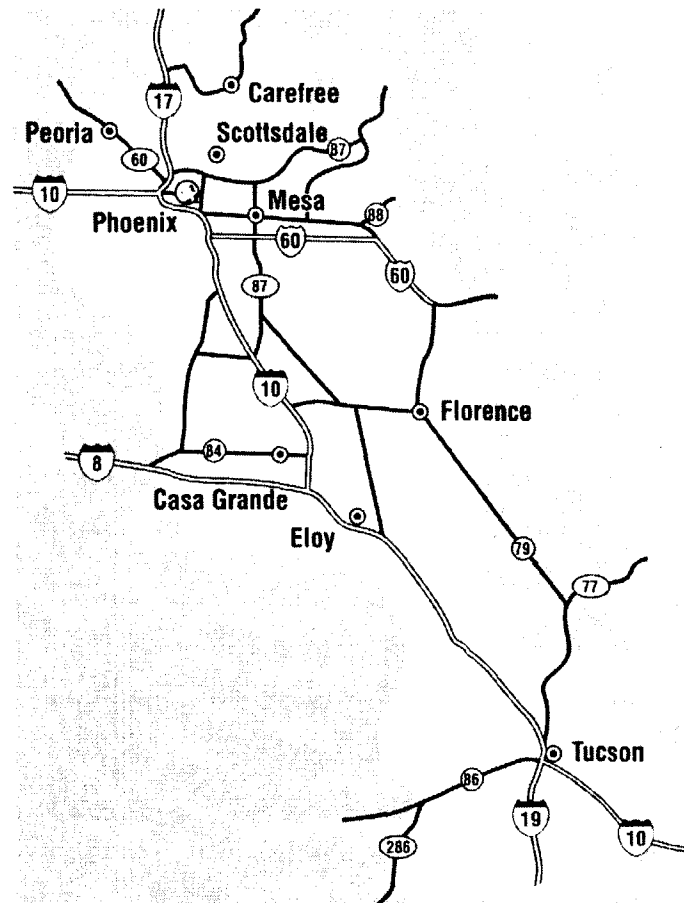
NEXTEL SERVICES ARE OFFERED WITHIN AND BETWEEN SERVICE AREAS THAT COVER LARGE GEOGRAPHIC AREAS AS ILLUSTRATED IN THE FOLLOWING TWO EXAMPLES
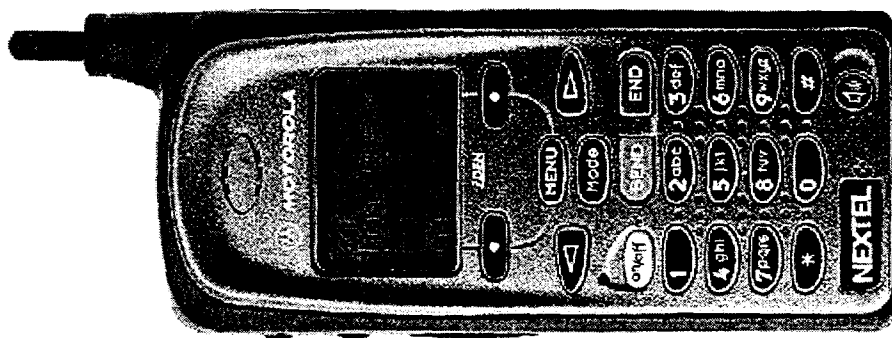
BALTIMORE/WASHINGTON SERVICE AREA
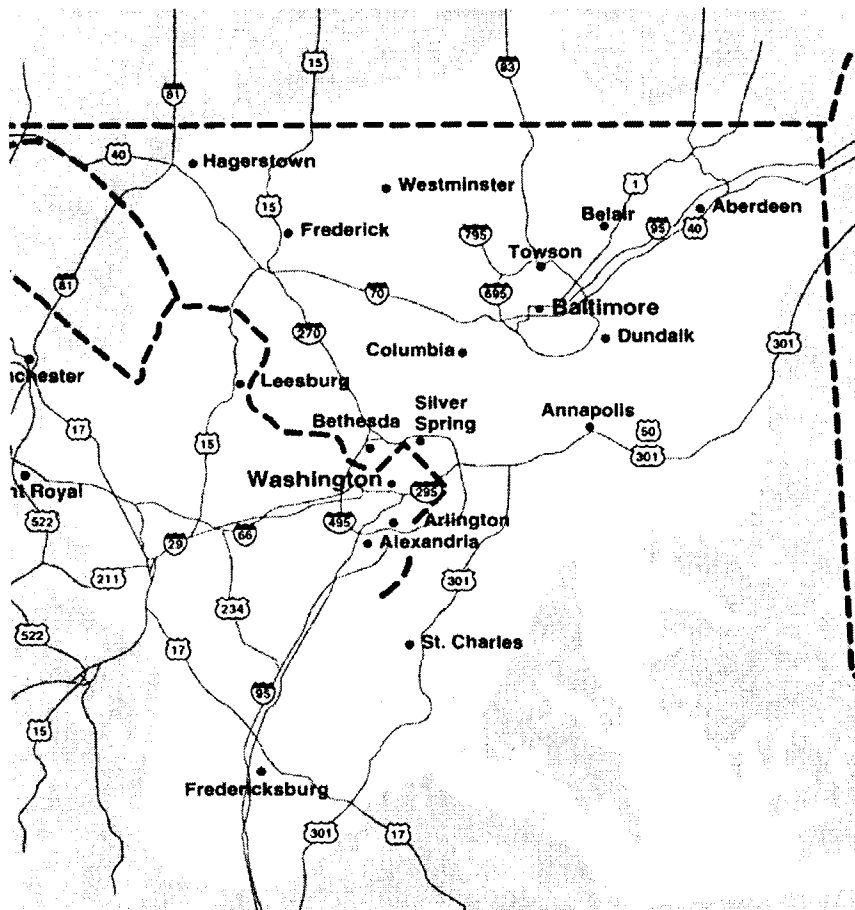
PHOENIX/TUCSON SERVICE AREA

Source: Nextel

DTMF (Touch tone) Dialing Pad

II-5F

NEXTEL'S CELLULAR TELEPHONE SERVICE OPERATES SIMILAR TO CELLULAR OR PCS WIRELESS SERVICES

- Each subscriber is assigned a 10-digit phone number based upon the North American Numbering Plan
  - Subscriber location and routes are tracked by the network
  - Hand-off capabilities between antenna sites provide seamless communications
  - Outgoing calls are made by entering a number then pressing the "SEND" button
  - Incoming calls are answered by pressing the "SEND" or "PHONE" button

- Nextel offers a number of additional features associated with its interconnected service
  - Voicemail   -   Call hold
  - Call waiting   -   No-answer or busy-signal transfer
  - Call forwarding   -   Three-way conference calling
  - Two lines

- The cellular service is operational in any Nextel service area, and Nextel users are not required to perform any additional operating steps with the handsets when they are outside their home service area

- Nextel plans to own and operate a nationwide digital network; therefore, it does not have any roaming or interoperability agreements with any other wireless service provider in the United States
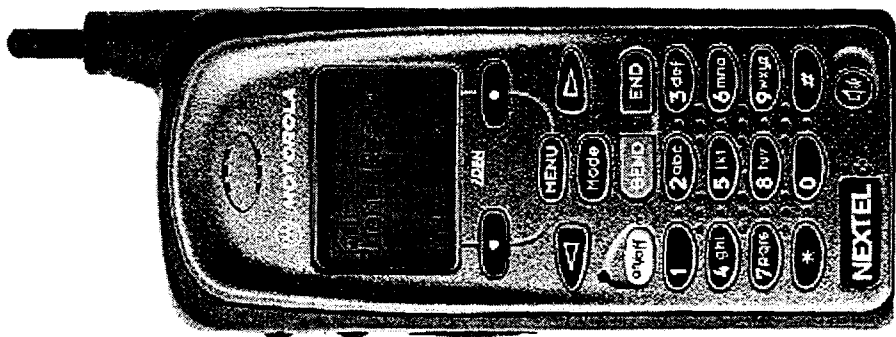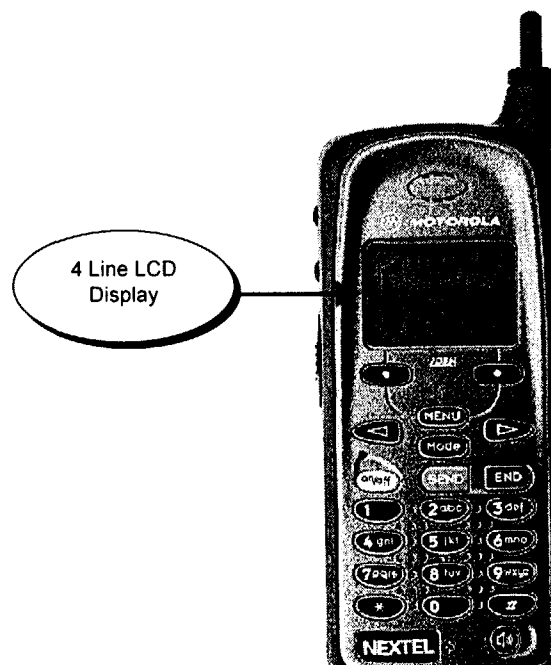
Push-to-Talk
Button

II-6F

THE DISPATCH SERVICE, A PUSH-TO-TALK SERVICE SIMILAR TO LAND MOBILE RADIO, IS MARKETED OR REFERRED TO AS "DIRECT CONNECT"

- The Direct Connect service enables subscribers to set up a conference on either a Private Call (i.e., one-to-one) or Group Call (i.e., one-to-many) basis
  - These groups are generally referred to as talkgroups
  - Nextel subscribers can establish up to as many as 100 Private Call entries, depending on model of the phone
  - The Direct Connect service is operable only within a user's home service area, but Nextel plans to enhance its networks to allow a subscriber to use the service between service areas

- A Private Call is made by depressing the "Mode" button on the phone and selecting the "Prvt Ready" function
  - A list of preprogrammable names of users can be scrolled using the arrow keys to select the intended recipient or the user can manually enter the intended recipient's phone ID number
  - The user must press the push-to-talk (PTT) button on the side of the phone, wait for a chirp that indicates connection, and then speak into the mouthpiece
  - The user must release the PTT to listen

- When receiving a Private Call, a user will hear a single alert tone, the name or number of the caller will be displayed, and the call will start

- A Group Call is made by depressing the "Mode" button to select the "Group Ready" function
  - The user then must scroll through a list of preprogrammed talkgroups or manually enter the talk group number
  - The user then presses the PTT button, waits for the chirp, and can begin talking

- Nextel offers Business Net Services that expand the Direct Connect concept to groups of users in a particular service area that are within a single industry or interest group (e.g., construction network)

THERE ARE SEVERAL STEPS ASSOCIATED WITH THE ESTABLISHMENT AND MAINTENANCE OF DIRECT CONNECT TALK GROUPS AND PRIVATE CALL GROUPS

- Nextel customers contact a Nextel sales representative or distributor to establish a banner account, in which each subscriber unit's Private ID and Talk Group ID will reside

- The customer account is assigned a fleet number and registered in the Nextel network along with the name of the user under the banner account
  - The customer informs Nextel of their desired talk group structure
  - Up to 255 talk groups can be established under one banner account
  - Nextel customers cannot configure their own talk groups
  - Additions or deletions of users, talk groups, or phone units (e.g., lost or stolen phones) must be made through Nextel

- Users and talk groups are established through one Nextel point of contact to help prevent outside users from being able to join a talk group

- The time required to establish a new talkgroup or change the structure of an existing talkgroup depends on the complexity of the request, but it usually can be completed the same day the request has been made

- Nextel Organizer™ is a software package that facilitates the organization and display of talkgroups at the user-level by enabling individual and talkgroup names to be programmed into each phone
  - The software is compatible with Windows 3.1, Windows for Workgroups or Windows 95
  - The software package includes disks, manual, and cable to connect the phone to a PC
  - Nextel Organizer™ costs $59.95

4 Line LCD
Display

NexNote	NexNote Plus
• Typed messages up to 140 characters in length • Directory of up to 50 subscriber names and telephone numbers • Online acknowledgement feature to indicate receipt of the message • Ability to preview messages before sending • Stores all messages for those handsets not in range or not powered on • Compatible with DOS, Windows™, and Macintosh^R operating systems	• Allows the computer user to delete, replace, or check the status of a message that has not yet been delivered • Delivery time and date stamp • Printable messages • Allows messages to be sent to customized groups or to an individual • Messages can be sent to pagers not on the Nextel network • Directory feature holds an unlimited number of personal telephone numbers from the Nextel network and most pager numbers from other networks • Long messages are automatically split into multiple messages

ALPHANUMERIC MESSAGES CAN BE SENT TO NEXTEL SUBSCRIBERS VIA PERSONAL COMPUTERS OR OTHER SERVICES

- Users can receive messages if they are in a Nextel service area

- NexNote™ and NexNote Plus™ are software packages used for sending text messages from a personal computer with a modem
    - The facing page illustrates the features of each service
    - These messaging software packages are priced at $15 and $50 for NexNote and NexNote Plus, respectively

- There are four other methods for sending text messages or numeric pages to a Nextel customer:
    - NEXGRAM is an operator-assisted messaging service which transcribes voice messages into text and sends it to Nextel handsets
    - NEXPAGE is a numeric paging service that sends a numeric page directly to Nextel handsets
    - Text messages can be sent directly from the Nextel Web site
    - Text messages can be sent from any Internet electronic mail application

- Nextel Voice Mail will store messages when the phone is off or when the user is on another call or out of range, and will then notify an available user of the message and its relative urgency

- Automatic callback is a Nextel phone feature that enables a user to quickly dial a phone number contained in a text or numeric page by simply pressing the "Send" key

Integrated Service Plans WASHINGTON DC	Performance Plus 60	Performance Plus 150	Performance Plus 300
Monthly Access	$69	$89	$109
Digital Cellular Minutes Included	60	150	300
Additional Digital Cellular Minutes	$.30	$.25	$.23
Nextel Direct Connect Minutes Included	150	150	150
Additional Direct Connect Minutes	$.10	$.10	$.10
Long Distance	$.15	$.15	$.15
Numeric Pages	Unlimited	Unlimited	Unlimited
Text Messages	25	25	25
Basic Voice Mail	Included	Included	Included
Enhanced Voice Mail	$5	$5	$5
Caller ID* (limited availablity)	$3	$3	$3
Additional Line (i600 only)	$10	$10	$10

Integrated Service Plans ATLANTA, GA	Performance Plus 50	Performance Plus 250	Performance Plus 500
Monthly Access	$55	$105	$165
Digital Cellular Minutes Included	50	250	500
Additional Digital Cellular Minutes	$.35	$.27	$.25
Nextel Direct Connect Minutes Included	Unlimited	Unlimited	Unlimited
Additional Direct Connect Minutes	$0	$0	$0
Long Distance	$.15	$.15	$.15
Numeric Pages	25	25	Unlimited
Text Messages	15	15	25
Basic Voice Mail	Included	Included	Included
Enhanced Voice Mail	$5	$5	$5
Caller ID* (limited availablity)	$3	$3	$3
Additional Line (i600 only)	$10	$10	$10

Integrated Service Plans LOS ANGELES, CA	Performance Plus 400	Performance Plus 800	Performance Plus 1000
Monthly Access	$64.99	$89.99	$219.99
Digital Cellular Minutes Included	400	800	1000
Additional Digital Cellular Minutes	$.30	$.25	$.23
Nextel Direct Connect Minutes Included	50	50	50
Additional Direct Connect Minutes	$.12	$.12	$.12
Long Distance	$.15	$.15	$.15
Numeric Pages	Unlimited	Unlimited	Unlimited
Voice Mail	$3	$3	$3
Text/Numeric Paging	$3	$3	$3
Caller ID* (limited availablity)	$3	$3	$3
Enhanced Services Value Package **	$6	$6	$6
Additional Line (i600 only)	$10	$10	$10

THE COST FOR THESE SERVICES VARIES IN EACH MARKET AND LARGELY DEPENDS ON THE CELLULAR AND DIRECT CONNECT MINUTES INCLUDED IN VARIOUS SERVICE PLANS
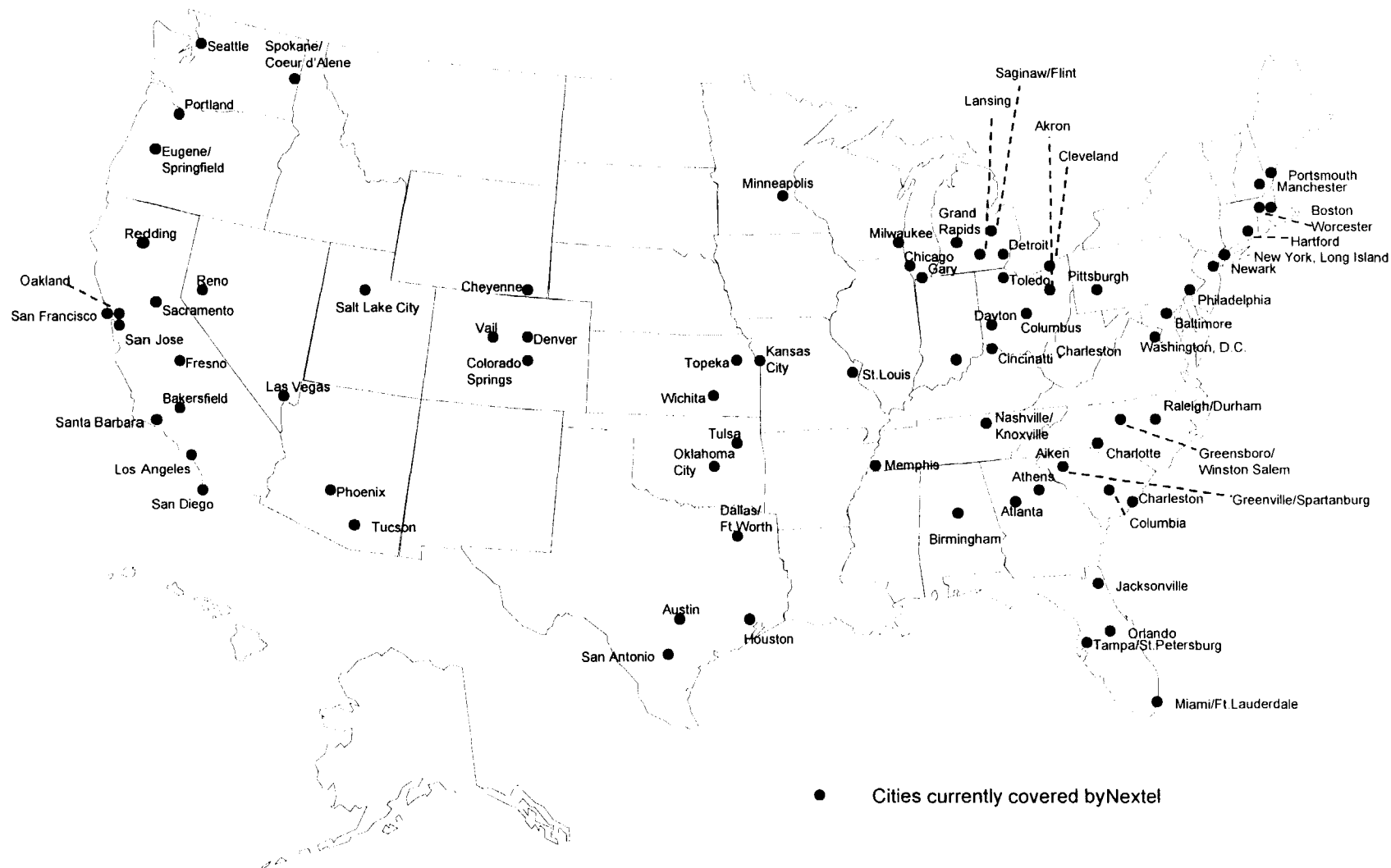
- The facing page is a sample of Nextel's rates in Washington, D.C, Atlanta, and Los Angeles

- Customers are billed according to several principles
    - No roaming and access fees are charged between service areas
    - Once a user surpasses the plan's threshold of included-minutes, a flat per-minute rate is charged
    - When customers travel anywhere outside their service area, they are charged their home service area cellular rate
    - Customers are billed on a per-second rate for Direct Connect calls and after the first minute of a cellular call

- Billing for the Direct Connect service accounts for each user in a talk group
    - Airtime for service plans with the same number of included Direct Connect minutes is pooled at the account level
    - Call duration is timed and multiplied by the number of participants involved in the Direct Connect call
    - The call initiator is billed for the call
    - Private calls and Group calls are billed at the same per-person rate

- A fee of $.15 per minute is charged for long distance calls in addition to the home area cellular service rate

NEXTEL USES DIRECT AND INDIRECT DISTRIBUTION CHANNELS TO SELL ITS SERVICES AND EQUIPMENT...

- Nextel sells directly through local corporate offices, a toll-free phone number, and its corporate Web site

- Nextel is developing an indirect dealership network through marketing agreements with companies that specialize in sales, direct marketing, and distribution

- In August 1997, Nextel signed an agreement with Brightpoint, Inc., to distribute, warehouse, and provision equipment for Nextel across the United States
  - Service providers are increasingly switching from in-house distribution to independent distribution services to lower overall costs and efficiently store and move products
  - Brightpoint is one of the largest distributors of wireless handsets and accessories in the world
    - •• Decentralized distribution centers
    - •• Several day turnaround on orders

- In October 1997, Nextel authorized four major companies to market its services and products nationwide
  - Hello Direct is a large marketer of telephone end-user equipment (e.g., headsets and wireless products
  - BearCom is a nationwide dealer with sales representatives in 25 cities
  - TIC Enterprises, LCC is a sales and marketing firm with more than 400 sales representatives
  - Pana-Pacific manages a network of more than 1,000 dealers and distributes products from eight warehouses throughout the United States

IT TYPICALLY TAKES 5–7 DAYS TO ESTABLISH INTIAL TALKGROUPS AND GRANT NEW PHONES ACCESS TO THE NEXTEL NETWORK

MAJOR CITIES SERVED BY NEXTEL, JUNE 1998

Seattle Spokane/ Coeur d'Alene
Portland
Eugene/ Springfield
Redding
Oakland
Reno
San Francisco Sacramento
San Jose
Fresno
Bakersfield
Santa Barbara
Los Angeles
San Diego
Phoenix
Tucson

Salt Lake City
Cheyenne
Vail
Denver
Colorado Springs
Las Vegas

Minneapolis
Milwaukee
Chicago
Gary
Topeka
Kansas City
Wichita
Tulsa
Oklahoma City
Dallas/ Ft.Worth
Austin
San Antonio
Houston

Saginaw/Flint
Lansing
Akron
Cleveland
Grand Rapids
Detroit
Toledo
Pittsburgh
Dayton
Columbus
Cincinatti Charleston
St.Louis
Nashville/ Knoxville
Memphis
Aiken
Athens
Atlanta
Birmingham

Portsmouth Manchester
Boston
Worcester
Hartford
New York, Long Island
Newark
Philadelphia
Baltimore
Washington, D.C.
Raleigh/Durham
Charlotte
Greensboro/ Winston Salem
Charleston Greenville/Spartanburg
Columbia
Jacksonville
Orlando
Tampa/St.Petersburg
Miami/Ft.Lauderdale

● Cities currently covered byNextel

II-11F

NEXTEL PLANS TO OFFER ITS DIGITAL SERVICES NATIONWIDE AND HAS ACQUIRED SPECTRUM TO ACHIEVE THAT GOAL

- Nextel spent $88.8 million to acquire 475 of the 525 licenses awarded by the FCC in an 800 MHz SMR auction in late 1997
    - On average, Nextel won rights to almost 10 MHz of spectrum in areas covering all 50 states and approximately 98 percent of the U.S. population
    - By combining frequencies formerly owned by Nextel with recently awarded frequencies, Nextel now possesses on average 15 MHz of usable spectrum in major U.S. markets and approximately 10 MHz of spectrum in the entire country
    - The auction results represent an estimated gain of 30,000 additional frequencies throughout the United States
    - On February 20, 1998, two parties filed petitions with the FCC to deny all of Nextel's applications for the licenses won in the auction

- Once the auctions proceedings are finalized, the FCC has mandated that Nextel or any license winner offer its services in each of its license areas within 3 years

- Nextel has acquired the rights to contiguous spectrum, which should increase its operating efficiencies in each service area
    - The company has committed to the deployment of iDEN networks, and efficient operation of the iDEN system requires access to a certain number of contiguous 800 MHz frequencies
    - Nextel will relocate its analog customers and incumbent licensees to alternative SMR channels
    - To facilitate the transfer, Nextel purchased 177 licenses of the 900 MHz bandwidth in the April 1996 FCC spectrum auction and will likely participate in the 800 MHz lower 200 channel auction

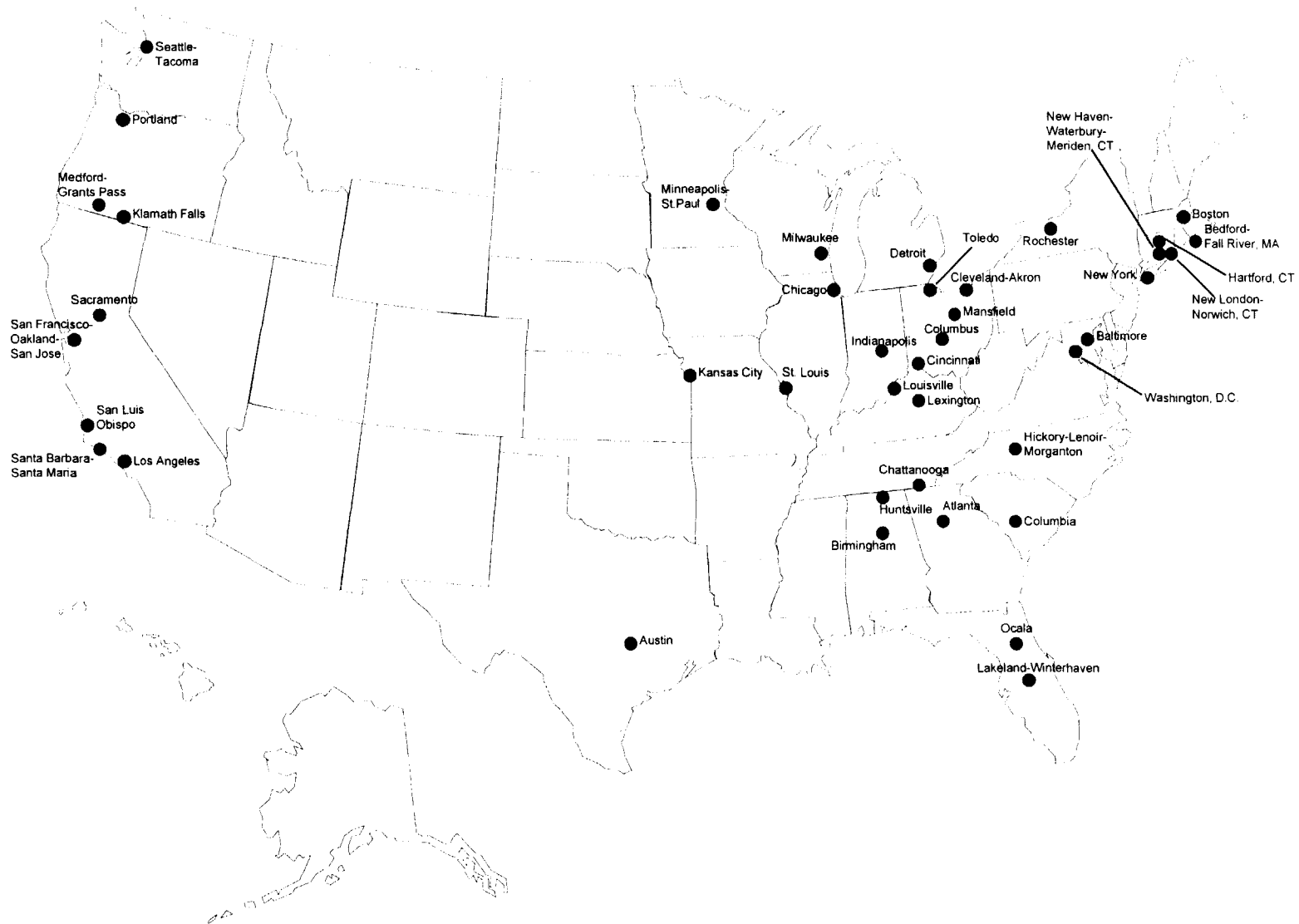# NEXTEL INTERNATIONAL MARKET PRESCENCE

NEXTEL IS TARGETING THE INTERNATIONAL MARKET AS A KEY AREA FOR FUTURE DEMAND AND GROWTH

- The company's strategy is to focus on under-served business and consumer markets in the developing world
    - Nextel is pursuing a strong presence in Brazil, Argentina, China, Shanghai, the Philippines, Canada ,and Mexico
    - The company has roaming agreements with Clearnet Communications in Canada and Mobilcom in Mexico, allowing customers to communicate across North America
    - Nextel's wireless reach is the largest of any telecommunications company in the Western Hemisphere

- International expansion is a significant component in Nextel's strategy
    - Its most recent investment in January 1998 was the entry into a new joint venture in Peru, in which the company purchased a 70-percent interest in Valorcom S.A., known as Nextel Peru, for $27.9 million
    - Nextel Peru is currently offering analog SMR services in the greater Lima area, but the company plans to upgrade its services to digital iDEN-based services in 1999

- Nextel now holds 100-percent equity interest in its Mexican and Argentine operating subsidiaries
    - In 1997, Nextel increased its interest in Comunicaciones Nextel de Mexico S.A. de C.V. from 30 percent to 100 percent at a cost of $132.2 million
    - Similarly, Nextel acquired the remaining 50 percent equity interest in Nextel Argentina for $46 million
    - Nextel Argentina also increased its total spectrum holdings to 12 MHz after it acquired 60 more SMR channels in Buenos Aires

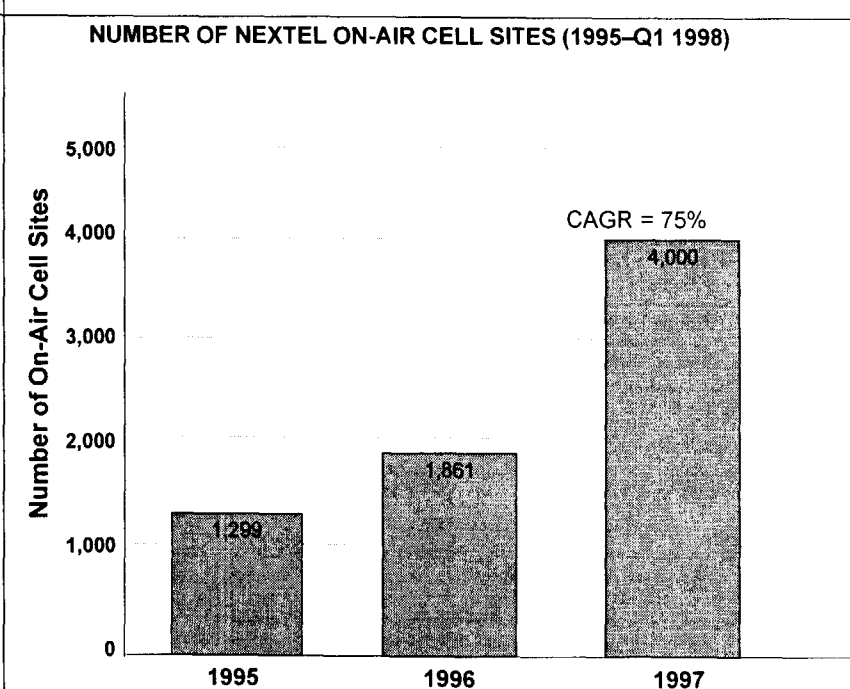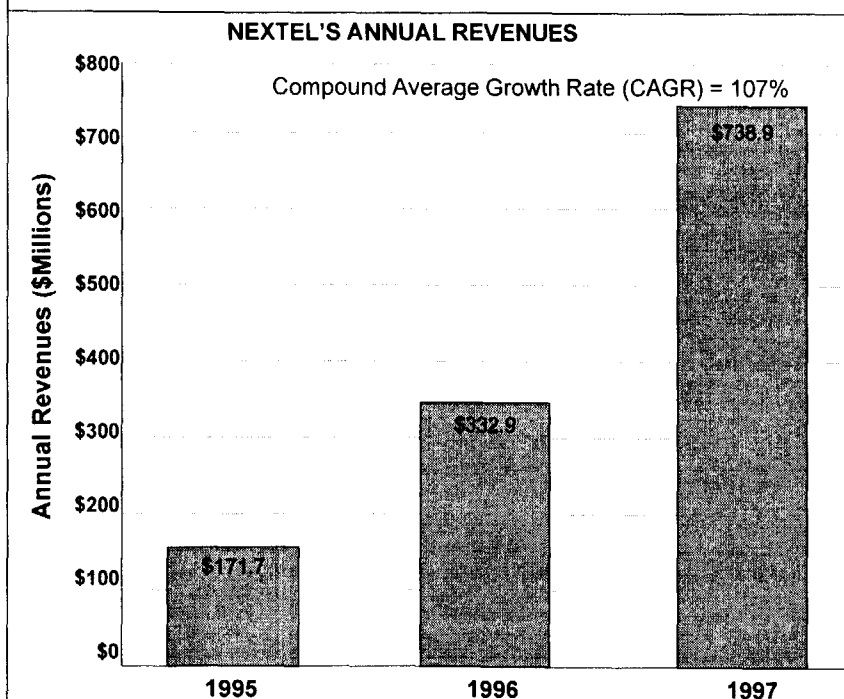# LMDS AUCTION METROPOLITAN STATISTICAL AREAS WON BY NEXTBAND
March 25, 1998

Seattle-Tacoma

Portland

Medford-Grants Pass

Klamath Falls

Sacramento

San Francisco-Oakland-San Jose

San Luis Obispo

Santa Barbara-Santa Maria

Los Angeles

Austin

Minneapolis-St.Paul

Milwaukee

Chicago

Detroit

Toledo

Cleveland-Akron

Mansfield

Columbus

Indianapolis

Cincinnati

Kansas City

St. Louis

Louisville

Lexington

Chattanooga

Huntsville

Birmingham

Atlanta

Columbia

Hickory-Lenoir-Morganton

Ocala

Lakeland-Winterhaven

Rochester

New York

New Haven-Waterbury-Meriden, CT

Boston

Bedford-Fall River, MA

Hartford, CT

New London-Norwich, CT
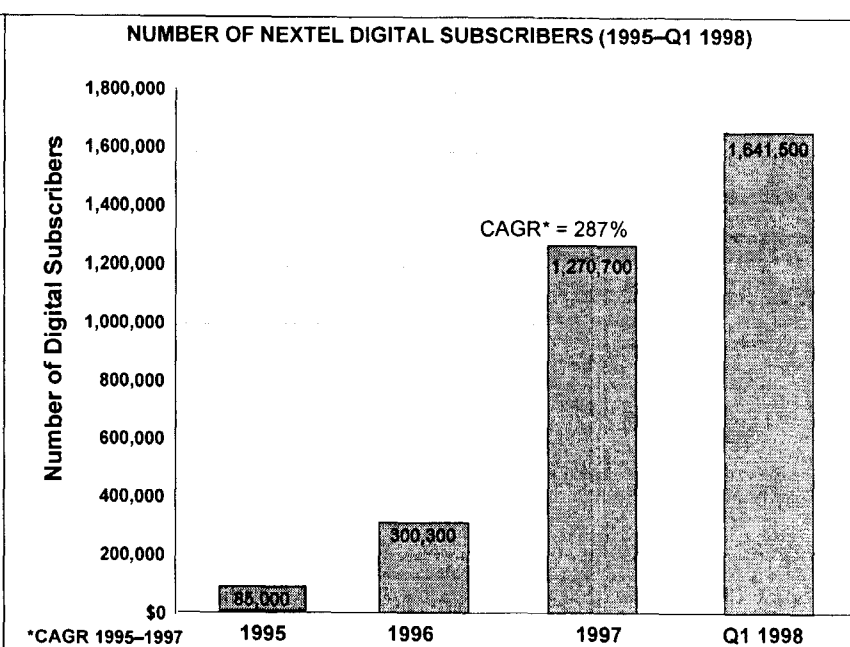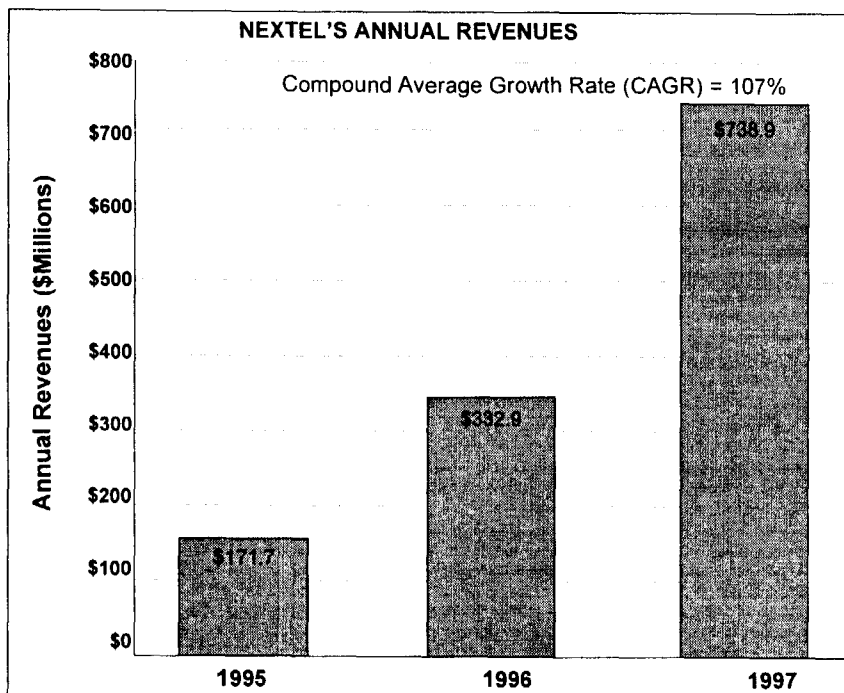
Baltimore

Washington, D.C.

NEXTEL ALSO OWNS THE RIGHTS TO A SIGNIFICANT AMOUNT OF LOCAL POINT MULTIPOINT DISTRIBUTION SERVICE (LMDS) LICENSES ...

- Nextel has entered into a joint venture with NextLink Communications, Inc., to provide LMDS
    - An LMDS system is capable of offering subscribers a range of one- and two-way broadband services, such as video programming, teleconferencing, wireless local loop telephony, and high speed data transmission (e.g., Internet access)
    - LMDS systems consist of a multicell configuration, with each cell containing a centrally located transmitter and multiple receivers

- The joint venture is being conducted through NextBand Communications, L.L.C.

- On February 18, 1998, NextBand participated in the FCC's LMDS spectrum auction of spectrum in the 28 GHz to 31 GHz range
    - As of the conclusion of the LMDS spectrum auction on March 25, 1998, NextBand had submitted $134.7 million in bids that represented the highest bids with respect to the auction of LMDS spectrum in 42 Basic Trading Areas, covering approximately 96 million people throughout the United States
    - Under the terms of the joint venture, one-half of the bid amount will be funded by Nextel

HOWEVER, IT IS UNCLEAR HOW OR IF NEXTEL WILL INTEGRATE ITS SMR AND LMDS SERVICES

NEXTEL HAS OVERCOME SIGNIFICANT FINANCIAL ISSUES AND TECHNOLOGICAL PROBLEMS RELATED TO ITS INFRASTRUCTURE EQUIPMENT

- In late 1993, Nextel deployed the first of its digital networks in the Los Angeles area, relying on Motorola's iDEN technology for its infrastructure
  - During that time, the company experienced performance issues with respect to the iDEN system's reliability, accessibility, and voice transmission quality
  - Customers were given discounts and credits to maintain relations
  - Motorola quickly improved and reconfigured the iDEN technology, particularly the voice transmission quality
  - All of Nextel's digital networks rely on reconfigured iDEN equipment

- MCI, a key ally of Nextel's at the time, severed its business interest in the company; consequently, Nextel market valuation and financial soundness seriously suffered

- The subsequent management team of McCaw, Akerson, and Donahue has demonstrably refocused the company's direction and commitment to its business plan

- Nextel is rapidly building out its nationwide digital network and, according to the Strategis Group, is adding subscribers to its network faster than any other wireless service provider

NEXTEL'S ANNUAL REVENUES

Compound Average Growth Rate (CAGR) = 107%

Annual Revenues ($Millions)

$171.7 (1995), $332.9 (1996), $738.9 (1997)

NUMBER OF NEXTEL DIGITAL SUBSCRIBERS (1995–Q1 1998)

Number of Digital Subscribers

CAGR* = 287%

85,000 (1995), 300,300 (1996), 1,270,700 (1997), 1,641,500 (Q1 1998)

*CAGR 1995–1997

NEXTEL'S ANNUAL REVENUES

Compound Average Growth Rate (CAGR) = 107%

Annual Revenues ($Millions)

$171.7 (1995), $332.9 (1996), $738.9 (1997)

NUMBER OF NEXTEL ON-AIR CELL SITES (1995–Q1 1998)

Number of On-Air Cell Sites

CAGR = 75%

1,299 (1995), 1,861 (1996), 4,000 (1997)

Source: Nextel, Booz·Allen & Hamilton analysis

II-15F

NEXTEL HAS NOT ACHIEVED OPERATING PROFITABILITY, BUT THE COMPANY EXPECTS TO BE PROFITABLE BY 2001

- The nature of the wireless industry is such that substantial upfront investments in technology, spectrum acquisition, and construction are required to build a nationwide network; and advertising, marketing, and end-user equipment subsidies are needed to gain customers

- In the past year, Nextel achieved a significant expansion of its digital network and experienced a large increase in system minutes of use
    - Service availability expanded from 6 to 79 of the top 100 metropolitan statistical areas
    - Total net system minutes of use increased from approximately 94 million in January 1997 to approximately 403 million in December 1997
    - Nextel has more than 4,000 constructed sites at leased locations in the United States for its digital network; approximately 2,100 sites were placed in service in 1997 alone
    - In 1998, NEXTEL plans to spend approximately $1.3 billion on its digital system infrastructure and add 1,800 sites

- Growth in total revenue, customer subscriber base, and average revenue per subscriber are three key indicators that will measure Nextel's performance
    - During 1997, Nextel's total revenue grew by 122 percent to $738.9 million, up from $332.9 million in 1996
    - As of March 31, 1998, Nextel provided service to approximately 1,641,500 digital subscribers in the United States
    - Monthly customer turnover, known as churn, is traditionally lower for SMR services than other wireless offerings; Nextel's churn was 1.3 percent in 1997 compared to the wireless industry's average of 1.9 percent
    - The monthly average revenue per digital subscriber is more than $65

- Nextel's performance was largely attributed to the company's marketing strategy, which targeted the wireless communications needs of business and other high usage customers

# III. NETWORK OVERVIEW

Network Overview...

THIS SECTION PROVIDES AN OVERVIEW OF NEXTEL'S NETWORKS

- The section will cover the following aspects of Nextel's networks
  - Build-out
  - Architecture
  - Reliability
  - Eavesdropping Safeguards
  - Cloning Safeguards

- A more detailed and technical discussion of Nextel's network architecture and call processes is in Appendix A

NEXTEL HAS IMPLEMENTED A BUSINESS PLAN FOCUSING ON AN ACCELERATED DEPLOYMENT OR BUILDOUT OF ITS DIGITAL NETWORK

- Pursuant to FCC regulations, Nextel must construct and operate a sufficient number of base stations to provide coverage to at least one-third of the population of a licensed area within 3 years; the percentage climbs to two-thirds at the end of 5 years

- It takes about 4 months to complete a Nextel radio design plan

- The site acquisition process for the initial system to be constructed in a market, depending on the number of sites, typically takes from 2 to 18 months
  - Based on proximity to targeted customers
  - Ability to acquire and build the site
  - Zoning and other regulatory issues

- Preparation of each site for equipment installation, including construction of equipment shelters, towers and power systems, grounding, ventilation and air conditioning, typically takes 6 weeks, whereas equipment installation, testing and pre-operational systems optimization takes an additional 6 weeks prior to commencing system operation

- In general, it takes between 18 and 24 months for Nextel to roll out initial operational capability in a given service area

NEXTEL'S CELLULAR-LIKE ARCHITECTURE


Conversation
"Hand-Off"
Between
Sites

III-3F
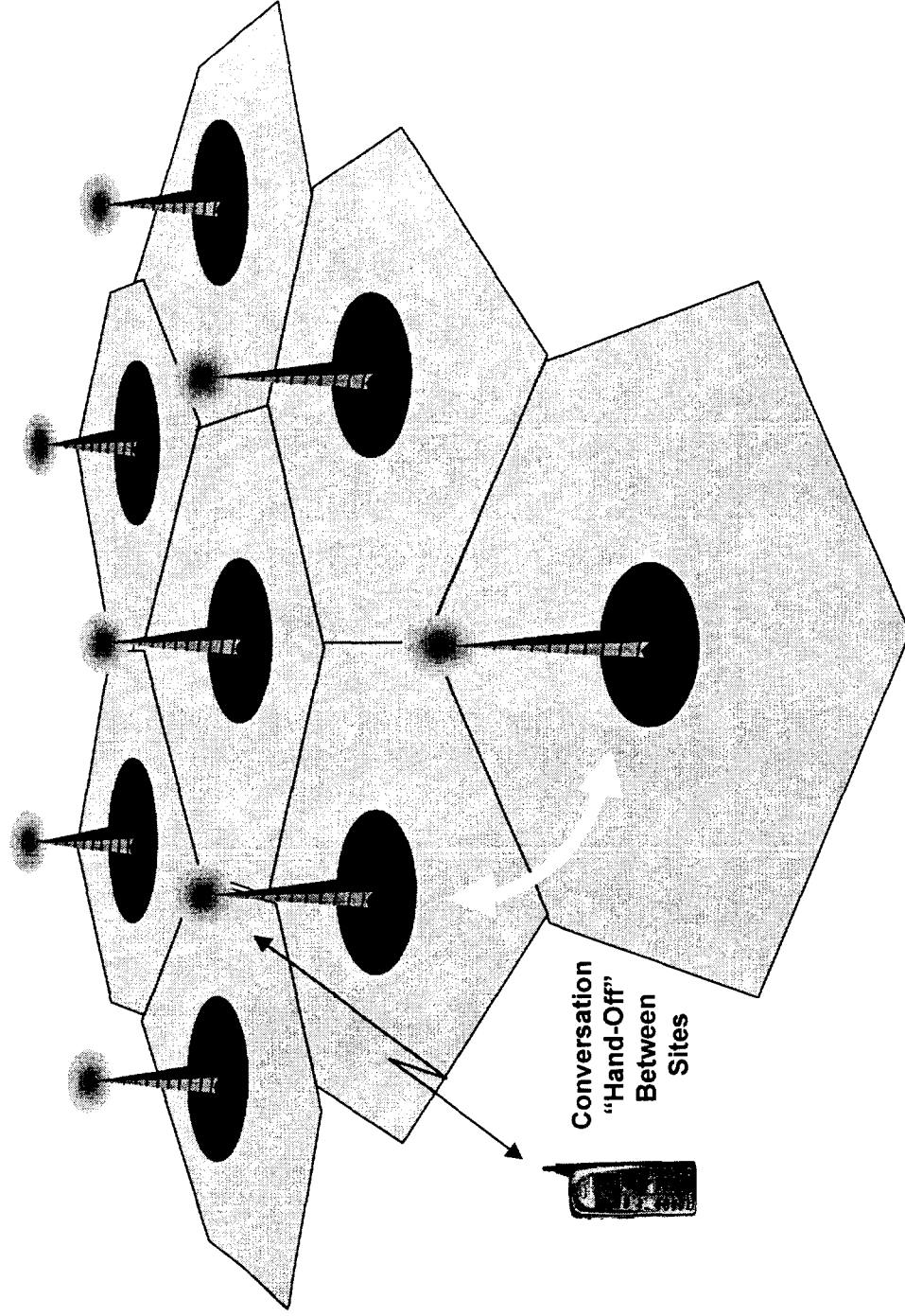
UNLIKE MOST SMR OPERATORS THAT TYPICALLY USE A SINGLE LARGE, POWERFUL TRANSMITTER TO COVER A GEOGRAPHICAL AREA, NEXTEL USES A CELLULAR-LIKE NETWORK ARCHITECTURE

- This type of architecture, illustrated on the facing page, places transmitters/receivers (transceivers) in numerous small "cells" within an area
  - The transceivers are controlled by a central processor, or switch, so that a Nextel subscriber can move between cells or frequencies and still maintain a conversation (i.e., handoff capability)
  - Cell sites typically have a radius of 2–10 miles

- This architecture enables Nextel to reuse the same frequencies repeatedly within a single service area
  - Since each cell is designed to use radio frequencies only within its boundaries, the same frequencies can be reused in other cells that are not far away
  - The reuse of frequency allows Nextel to handle a large number of simultaneous calls with a limited number of frequencies available
  - The hexagonal arrangement helps ensure enough separation exists between any two cells using the same frequencies so that interference does not occur

- The number of transceivers or channels in a given cell depends on the traffic that cell is expected to handle

- As traffic grows in the system, additional channels and cells can be added until all the available spectrum is in service
  - Capacity can be further enhanced by splitting a cell into two or more smaller cells
  - As the size of cells are reduced, the same frequencies can be used in more cells, which in turn means more subscribers can be supported by the system
  - A Nextel's cell site can accommodate a maximum of 24 channels if it is a sectored site or 20 channels if it is an omni-directional site configuration

- Following commencement of system operations in a selected market, Nextel expects to continually add new sites to improve coverage and capacity

NEXTEL HAS APPROXIMATELY 4000 CELL SITES CONSTRUCTED AND IN OPERATION IN ITS DIGITAL NETWORK

NEXTEL CELL SITE LOCATIONS
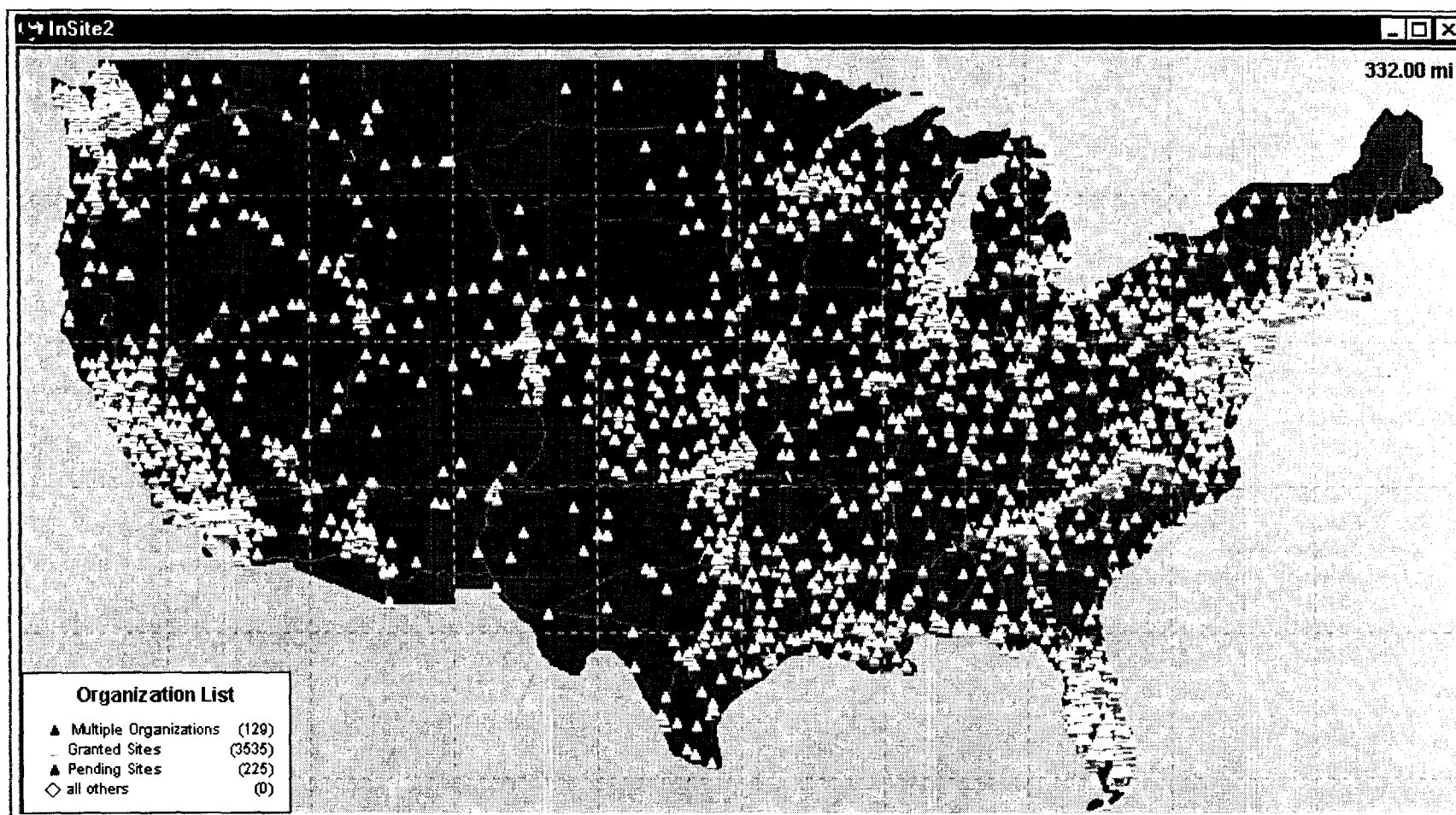
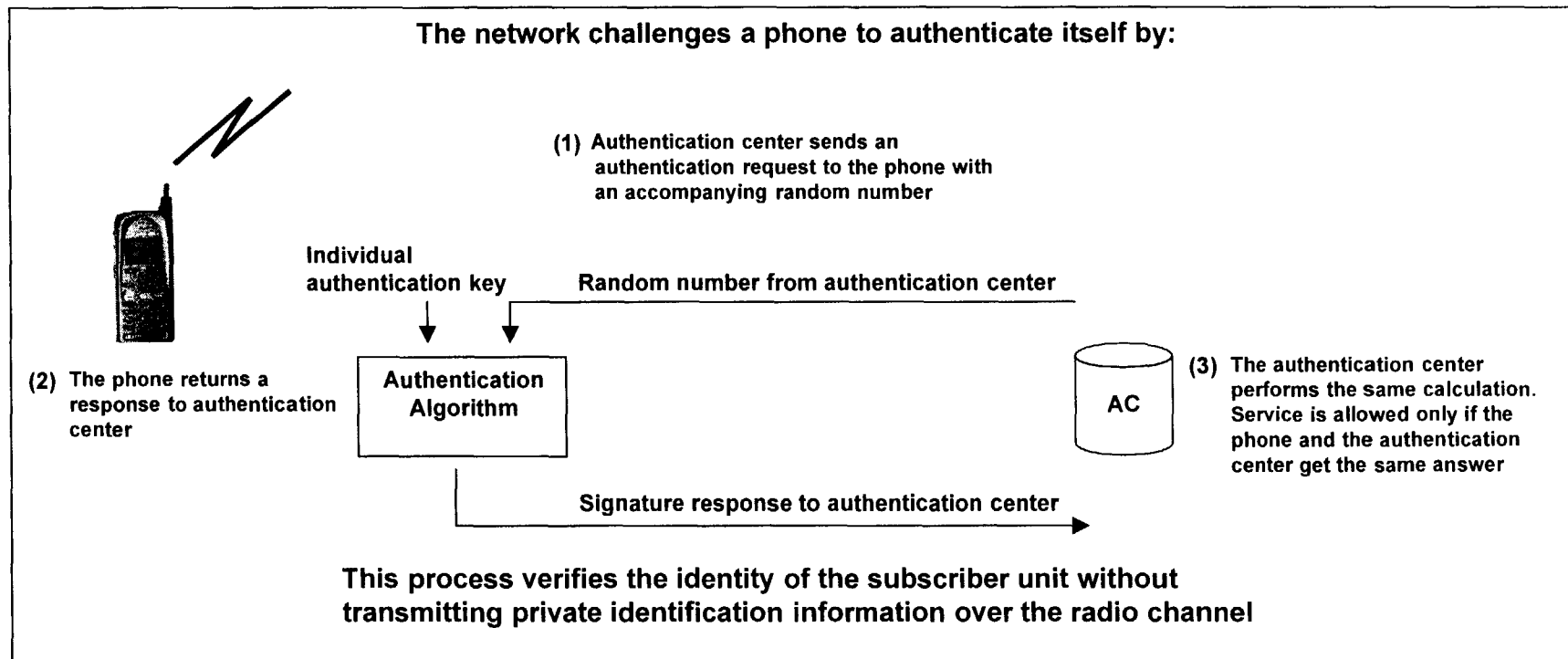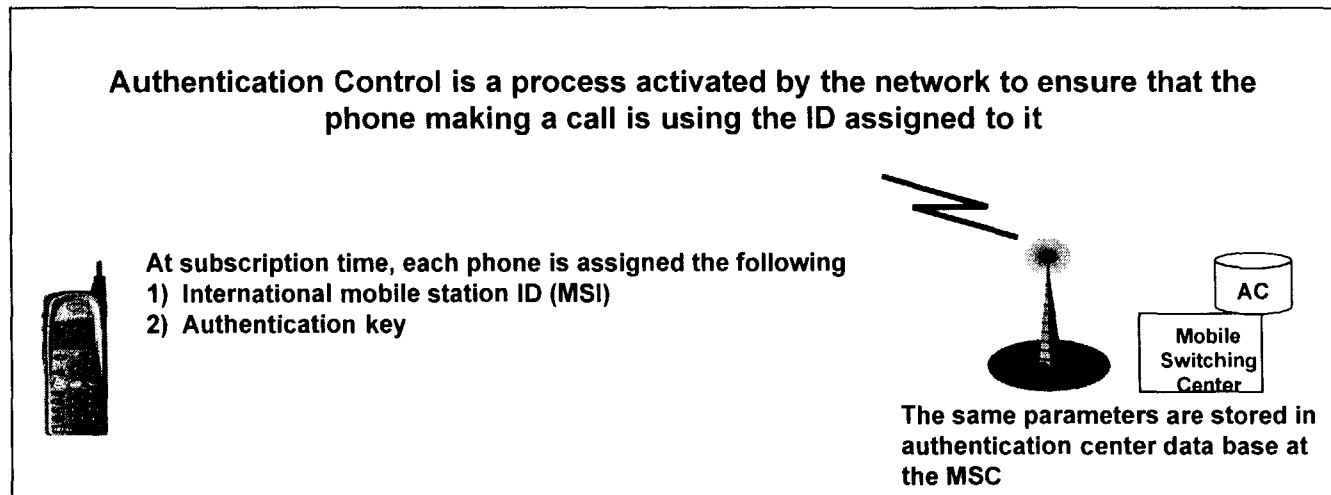Source: April 1998 PerCon/FCC Database

NEXTEL'S NETWORKS ARE ENGINEERED WITH GRADES OF SERVICE COMPARABLE TO OTHER COMMERCIAL WIRELESS SERVICES AND ARE COMPRISED OF FAULT TOLERANT EQUIPMENT

- Reliability reflects the ability of a user to access a service and complete a call; it is primarily determined by the capacity of the system and the performance of the network equipment

- Capacity planning is driven by demand characteristics and market information
  - Total number of subscribers forecasted for the network
  - Monthly minutes of usage per subscriber
  - Traffic intensity per subscriber

- Allocating demand is based on weighting certain demographic data within the service area
  - Population density
  - Income
  - Highway traffic intensity
  - Employment characteristics

- Based on an evaluation of this information, Nextel determines the number of channels required per cell and grade of service, which is the probability that a call will be blocked
  - The grade of service for Nextel's cellular service is 2 percent, which is consistent with other wireless service providers
  - The grade of service for the Direct Connect service is 5 percent

- The reliability of Nextel's network is also a function of the performance of its fixed network equipment
  - Critical controlling and switching equipment is designed so that failure of a critical component results in the transfer of functionality to redundant components
  - However, this transfer usually takes place within a piece of equipment and would not remedy the problems resulting from a piece of equipment that is physically damaged or destroyed

THE IDEN SYSTEM DOES NOT SUPPORT ENCRYPTION BUT HAS ATTRIBUTES THAT FOSTER LIMITED PRIVACY

- IDEN is a digital system that uses time division multiple access (TDMA) multiplexing technology for voice transmission
    - TDMA divides a voice channel into timeslots, each 15 milliseconds long
    - IDEN uses six-timeslot TDMA technology for two-way dispatch service and three-timeslot TDMA technology for mobile telephone interconnection
    - A person trying to intercept a call would need to consistently identify the timeslot of a particular communication

- IDEN also uses a compression algorithm for digitally encoding/decoding speech, so even if a user stream could be identified, the actual voice component of the transmission would still need to be decoded from the encoding using the compression algorithm

- Nextel does not use the Cellular Message Encryption Algorithm (CMEA)—the algorithm used to encode the digits depressed on many wireless key pads (and which was broken in March 1998)

NEXTEL USER AUTHENTICATION CONTROL PROCESS

Authentication Control is a process activated by the network to ensure that the phone making a call is using the ID assigned to it

At subscription time, each phone is assigned the following
1) International mobile station ID (MSI)
2) Authentication key

AC

Mobile Switching Center

The same parameters are stored in authentication center data base at the MSC

The network challenges a phone to authenticate itself by:

(1) Authentication center sends an authentication request to the phone with an accompanying random number

Individual authentication key   Random number from authentication center

(2) The phone returns a response to authentication center

Authentication Algorithm

AC

(3) The authentication center performs the same calculation. Service is allowed only if the phone and the authentication center get the same answer

Signature response to authentication center

This process verifies the identity of the subscriber unit without transmitting private identification information over the radio channel

Source: Motorola

USING AUTHENTICATION TECHNIQUES, THE NEXTEL NETWORK DETERS CLONING AND UNAUTHORIZED ACCESS TO THE SYSTEM

- In first generation cellular systems, mobile telephone numbers and serial numbers were often stolen from the airwaves and programmed into "cloned" handsets, allowing unauthorized service at the expense of actual users

- In analog conventional radio systems, radio users can select a channel, listen to group conversations, and gain unauthorized use of channels and repeater systems

- Each Nextel switch uses an authentication procedure to verify mobile station registration preventing cloned handsets from using service or gaining access to talk group conversations
  - Each handset has an authentication key assigned at subscription time and also stored at the switch authentication center (AC)
  - When a mobile station is powered on or roaming, the AC sends an authentication request with a random number to the mobile station
  - The mobile station uses the key to generate and send a response back to the AC; if the response matches the AC calculation, service is allowed

- The authentication process eliminates the need to send private identification data over the airwaves where it can be stolen and used to clone handsets

- To prevent transmitting user IDs over the air during interconnect call processing, a mobile station is assigned a temporary ID number each time it registers or roams; this process reduces the ability to pirate IDs for fraudulent access and eavesdrop conversations

IN ADDITION TO THE SERVICES AND FEATURES DESCRIBES SO FAR, THE iDEN SYSTEM SUPPORTS AN OPTIONAL ADVANCED FEATURE SET THAT NEXTEL HAS NOT DEPLOYED

- The advanced iDEN feature set includes 16 different levels of priority access, emergency call, status message, isolated site operation, and talk group scan

- Priority access enables the system operator to grant selected users access to a congested cell site presumably based on their relative importance to emergency or disaster relief
    - The FCC has issued a notice of proposed rulemaking regarding the establishment of rules and requirements for priority access service for public safety providers operating on commercial wireless services
    - Nextel filed comments with the FCC supporting priority access on a voluntary basis
        - •• Nextel argued that mandating carriers to provide priority access may not be necessary in light of the additional 24 MHz of public safety spectrum
        - •• Priority access has liability, network configuration, cost recovery, and cost of services issues that would need to be addressed by the FCC

- Emergency call is a feature often found on private LMR systems that allows a user to send an emergency alert that preempts existing calls and call requests

- Status Message enables a subscriber unit to transmit predefined operating status codes to a wireless dispatch console

- Isolated Site Operation is a feature that allows a dispatch call to continue even if connectivity between the site and the switching center is lost

- Talk Group Scan enables a subscriber to monitor and talk to as many as four talk groups; a subscriber can talk to only one talk group at a time on the current Nextel network

- Nextel is considering providing inter-service area Direct Connect service and talk-around capable phones

IV. PUBLIC SAFETY COMMUNITY'S USE OF NEXTEL SERVICES

THIS SECTION WILL FOCUS ON THE PUBLIC SAFETY COMMUNITY'S USE OF NEXTEL SERVICES TO FULFILL THEIR MISSIONS

- Nextel is currently supporting a wide range of public safety-related missions and organizations

- Representatives from various federal and local public safety organizations were interviewed over a two month period about their use of Nextel services

- This section will provide an overview of the way these organization are using the service
  - What missions are being supported by Nextel
  - What are the users perceptions about the service and equipment

- To maintain the anonymity of the organizations, no names or cities will be used in this section

- References to multiple federal agencies are differentiated by the names Federal Agency A, Federal Agency B, and Federal Agency C etc.

Public Safety Community's Use of Nextel Services...

FEDERAL LAW ENFORCEMENT AGENCY "A" HAS BEEN USING NEXTEL SERVICES SINCE OCTOBER 1997 TO SUPPORT BOTH ADMINISTRATIVE AND OPERATIONAL COMMUNICATIONS

- The agency was searching for an alternative to bulky and conspicuous private LMR radios
  - 67 model i370 phones with car kits were acquired for $224 a piece
  - The initial service package for each unit included 100 cellular minutes and 250 Direct Connect minutes for $55 per month, but the package was later changed to zero (0) cellular minutes and 500 Direct Connect minutes for $50 per month

- There have been instances of holes in coverage and inadequate service area coverage; system congestion has occurred during cellular call attempts

- The services are used on a daily basis, but Direct Connect is the most used for surveillance, investigation, arrests, and protective details
  - The handset functionality is considered excellent; digital voice quality is adequate
  - 13 talkgroups are established
  - Text messaging service is not used
  - Private LMR radios are still available and are used when there is a problem with the coverage
  - Nextel cellular service use is discouraged

- The office is currently evaluating the long term viability of Nextel as a cost effective communications tool
  - The Direct Connect Talkgroup feature has led to excessive bills
  - The agency would prefer to use the Talk Group function more but it would be cost prohibitive
  - During the first month of use, the agency exceeded its aggregate number of Direct Connect minutes by 16,000 minutes
  - Users had to be educated about the consequences of the liberal use of talk groups, and the use of the Direct Connect Private Call was encouraged whenever appropriate
  - The agency still has problems with keeping the Direct Connect additional charges to a minimum

Public Safety Community's Use of Nextel Services...

FEDERAL LAW ENFORCEMENT AGENCY "C" IS USING NEXTEL IN SEVERAL OFFICES AROUND THE COUNTRY

- A total of 50 phones are used in the several U.S. cities
  - Offices have been using the service between 6 to 18 months
  - The service package includes 250 Direct Connect Minutes and 90 Cellular minutes for $50 per user per month
  - Law enforcement sensitive communications involving surveillance, investigations, and arrests are made using the service

- Alphanumeric messaging and Private Direct Connect services are heavily used on a daily basis
  - All offices have the NextNote software package for sending text messages
  - Private LMR radios still available but are not used

- Users have asked Nextel to establish talk groups at times for various task forces, and Nextel has been very responsive in fulfilling the request

- Users believe that Nextel has generally better coverage compared to the private LMR systems in most of the cities

- There have not been any reports of system congestion for cellular or Direct Connect call attempts
  - Priority access has been requested but not granted
  - Nextel has stated that the company is considering implementing a priority access feature

- The service is considered an interim solution until a new private LMR system is built

FEDERAL LAW ENFORCEMENT AGENCY "D" IS USING NEXTEL SERVICES FOR ADMINISTRATIVE COMMUNICATIONS ONLY

- The agency has been using Nextel in one U.S. city since February 1998

- The agency has 40 i600 model Nextel phones configured with 9 different talk groups

- Nextel services are used for administrative communications; no operational communications are transmitted over the Nextel network

- The representative interviewed did not recommend the service be used for operational communications
  - Reliability concerns
  - Coverage concerns
  - Security concerns
  - No talk-around capability

- Agents have experienced coverage holes in the service area

- Agents were concerned with the fact that there was no audible notification that the user has lost coverage or is out of the service area; there is only a visual icon on the handset

- Agents carry cellular phones and LMR radios, and the office does not anticipate Nextel replacing either communications tool

- The office has had problems resolving billing issues with Nextel
  - Talkgroup charges
  - Office received 5 different bill statements

A LARGE METROPOLITAIN POLICE DEPARTMENT HAS RECENTLY STARTED USING NEXTEL SERVICES

- An intelligence unit responsible for protective services and anti-terrorism activities is using Nextel for operational and tactical communications
    - The unit has between 60 to 80 Nextel phones
    - Operational and administrative communications are supported by Nextel
    - Officers still carry private LMR radio, cellular phone, and pager

- Direct Connect dispatch and alphanumeric paging are the most used services
    - Private Direct Connect is extensively used
    - The unit has approximately four talk groups established

- There are no reported incidents of system congestion

- In general, coverage has been acceptable and not a problem, although there are mixed reports on the quality of in-building penetration

- The Nextel customer service is considered exceptional

- The organization is considering quadrupling the number of Nextel handsets if sufficient resources can be garnered

- Users do not consider Nextel services as a replacement to private LMR system or commercial cellular service but as another communications tool

Public Safety Community Use of Nextel Services…

A COUNTY SHERIFF'S OFFICES HAS JUST RECENTLY ACQUIRED NEXTEL SERVICES

- The department has purchased 25 phones

- The service package includes unlimited Direct Connect Private Calling service and 600 minutes of cellular service for $70 per user per month

- The department intends to use the phones for administrative communications primarily and operational communications on a limited basis

- Nextel network engineers met with county representatives to address coverage issues

- Based on that meeting, the representatives were satisfied with the general coverage of the service area and understand that there may be some holes in coverage

- Nextel representatives also addressed reliability issues and were informed that there was a possibility of system congestion and that all users should be aware and consider this in system planning and service use

IN GENERAL, THE PUBLIC SAFETY USERS INTERVIEWED FOR THIS REPORT WERE SATISFIED WITH THE NEXTEL SERVICES

- The reliability of the system has been good and users are aware of potential for system congestion and use private LMR systems accordingly

- The Nextel handsets were considered excellent and performed well
    - The handsets were easy to use and require little training
    - Voice quality was clear
    - The similar look of Nextel phones to cellular or PCS phones was considered to be an advantage
    - Battery life was exceptional
    - Some users, however, considered the PTT button too small

- Coverage has been adequate or better than private systems in some service areas
    - Coverage was comparable to other commercial services in some areas
    - Nextel has improved coverage since many organizations first procured their phones

- Customer Service was generally good
    - Major Account Customer Service is very responsive to customer needs
    - Nextel provided excellent training for phone use
    - Nextel has been responsive for talkgroup creation for new task forces

THERE WERE SOME NOTEWORTHY CONCERNS WITH THE SERVICES, NETWORK AND TECHNOLOGY PERFORMANCE

- The inability to use the Direct Connect service between service areas was a common complaint

- Nextel does not offer a priority access feature that would enable public safety users to communicate during network congestion
    - There were instances of network congestion for cellular calls but never for Direct Connect call attempts
    - Some users were concerned with the potential effects of increased subscriber growth on congestion, network performance, and reliability

- Nextel phones are not talk-around capable (i.e., able to support radio-to-radio communication when out of network coverage area)
    - Some public safety users and missions require talk-around capability
    - Nextel representatives have told the public safety community that talk-around capable iDEN phones were being considered but no plans were definite

- Some users noted the lack of in-building penetration in basements and elevators

- There is potential and examples of excessive service bills through the use of Direct Connect talkgroups
    - The cost of a Direct Connect call reflects the number of users on that talkgroup
    - Cultural issues can contribute to the liberal use of talkgroups (e.g., traditional LMR users use talk groups liberally, and are not necessarily usage sensitive)
    - This can create some difficulty in the adjustment to usage sensitive commercial dispatch service
    - Memorandums of Understanding or use parameters have been set up in some instances to efficiently manage the use of the service (i.e., use Private Call versus Talkgroup)

V. SUMMARY AND CONCLUSIONS

Summary and Conclusions...

NEXTEL'S SERVICE OFFERINGS AND CONTINUED IMPLEMENTATION OF ITS BUSINESS PLAN SHOULD POSITION THE COMPANY TO BE A LONG TERM PLAYER IN THE WIRELESS MARKET

KEY CUSTOMER SATISFACTION DRIVER	NEXTEL SERVICE ATTRIBUTES
Call Quality	• Digital network provides high quality voice communication • 800 MHz has good propagation and building penetration characteristics
Corporate Image: Credibility	• National brand strategy • Reconfigured IDEN technology provides integrated suite of services that no other wireless carrier offers • Growing pains have affected timely delivery of ready-to-use phones
Corporate Image: Corporate Capabilities	• Solid management structure committed to implementing business plan • Established credibility on Wall Street • Innovative reputation
Pricing Options	• Prepackaged minutes offer simple, easy to understand pricing structure • Nextel is willing to "deal" with users • No hidden charges
Customer Communications	• Broadening direct and indirect distribution channels • Major Account Customer Service is responsive • Some growing pains in large markets
Billing	• Bill can be confusing at first, due to Direct Connect • Users must be cautious with the use of talkgroup Direct Connect
Roaming/Coverage	• Rapidly deploying nationwide network • Coverage is good and should improve over the next 3-5 years • Phones only work where there is a Nextel network • One national network, so no roaming agreements
Cost of Roaming	• No roaming charge is a significant differentiator

Summary and Conclusions...

PUBLIC SAFETY ORGANIZATIONS WILL NEED TO EVALUTATE THEIR SPECIFIC OR UNIQUE FUNCTIONAL COMMUNICATIONS NEEDS AND RESULTING REQUIREMENTS AGAINST NEXTEL'S SERVICE ATTRIBUTES

MISSION	SAMPLE FUNCTIONAL COMMUNICATIONS NEEDS	RESULTING REQUIREMENTS	NEXTEL SERVICE ATTRIBUTES
• Surveillance • Investigations • Undercover wire operations • Fire • Emergency Response • Border management • Prison operations • Person protection • Hostage operations • Counter-terrorism • Search and rescue • Event control • Community policing	• Support operations and cases throughout organizations' jurisdictions	• Communications capabilities must be, local, regional, or national	• Building national network that will eventually support inter-service area dispatch
	• In-building and outdoor coverage	• Coverage must support in-building and outdoor coverage to include urban, rural, and rough terrain	• 800 MHz, digital iDEN network
	• Mobile communications in vehicle and on foot	• Service must support officials in vehicles and on foot	• Cellular-like configuration supports conversation hand-off
	• Ability to exchange sensitive information without interception	• Communications must be secure	• Digital TDMA, no encryption
	• Assured communications during emergency conditions	• Service must ensure consistently reliable communications, particularly during large scale emergencies	• Spectrally efficient technology, at least 10MHz of spectrum in most service areas, no priority access
	• Share information among various organizations	• Service must provide coordination for interoperable communications	• Direct Connect talkgroups
	• Easy to initiate, respond to, and use	• Handsets must provide quick call set-up, be easy to use, and support hands-free accessories	• Compact highly functional and easy to use handset, push-to-talk operation
	• Cost effective	• Service must support mission within budget constraints	• Pre-packaged service plans, additional minutes charged, no roaming fee

Summary and Conclusions...

THERE ARE A NUMBER OF FACTORS THAT WILL LIKELY LEAD THE PUBLIC SAFETY COMMUNITY TO INCREASE ITS USE OF NEXTEL OVER THE NEXT SEVERAL YEARS

- Nextel will have extensive nationwide availability and coverage within 3 to 5 years

- The company plans to continue to promote a national brand image and develop distribution channels to market and deliver its services

- Nextel is interested in gaining the public safety community as customers
    - Nextel actively markets the public safety community
    - In December 1997, Nextel filed comments with the FCC supporting the ability of commercial service providers to provide public safety communication services on the newly allocated 24 MHz of public safety spectrum
    - By donating phones to local users, Nextel is increasing its visibility and peaking interest within the public safety community

- Nextel offers an integrated package of services generally attractive to public safety users
    - Digital Cellular
    - Direct Connect push-to-talk dispatch similar to private LMR networks
    - Alphanumeric text messaging
    - Data (future)

- Nextel is considering adding inter-service area Direct Connect, talk-around capable phones, and priority access which would make its services even more attractive to the public safety community

- No other commercial service provider offers a comparable integrated service package on a national and international scale

Summary and Conclusions...

ORGANIZATIONS SHOULD CONSIDER SEVERAL ISSUES WHEN EVALUATING NEXTEL SERVICES

- Organizations must consider the costs of using Nextel services
  - Versus other commercial services
  - Versus upgrading or replacing private LMR infrastructure

- Security considerations will determine the extent to which Nextel services are used by individual public safety organizations
  - The Nextel network does not support encryption
  - Digital TDMA has privacy attributes but should not be considered completely secure

- Commercial service customers of the same provider are competing equities for limited resources, so unless priority access is available to public safety users, there will always be a reliability concern
  - Nextel networks are designed with grades of service similar to other commercial wireless networks which experience congestion
    - • 2 percent cellular GOS
    - • 5 percent dispatch GOS
  - The effect of large subscriber growth on system capacity is unknown

- As a customer, a public safety user will have little control over network performance and maintenance; there have been instances of prolonged network outages

- Despite aggressive deployment of Nextel's digital network, the network is still in its early stage and lacks the coverage of more mature commercial wireless networks, however, this should be resolved over the next 3 to 5 years
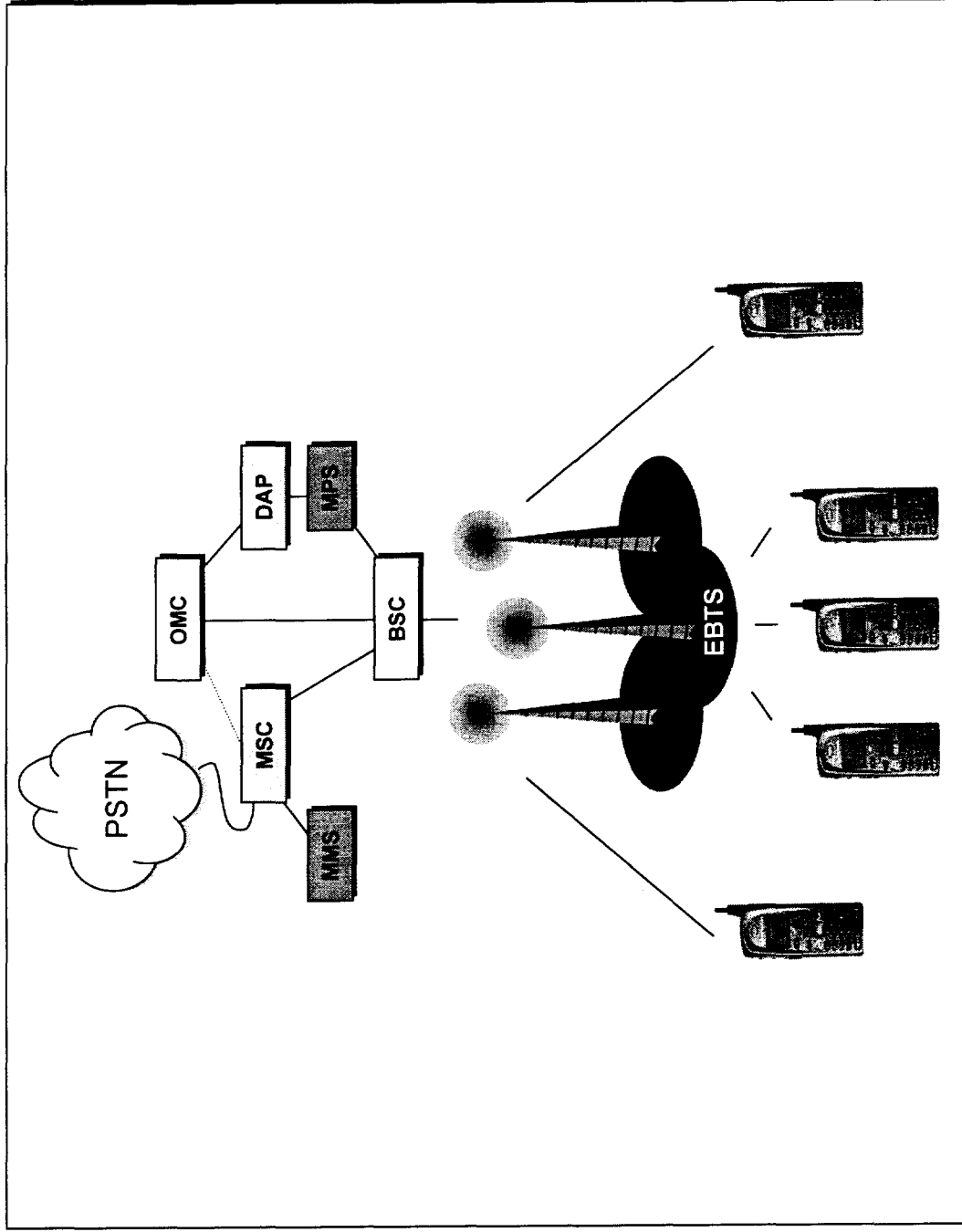
APPENDIX A: NETWORK ARCHITECTURE

Network Architecture...

THIS SECTION WILL FOCUS ON THE OPERATION OF NEXTEL'S DIGITAL NETWORKS

- Nextel's networks are comprised of several major elements
    - Enhanced Base Transceiver System (EBTS)
    - Base Site Controllers (BSC)
    - Dispatch Application Processor (DAP)
        - •• Home Location Register (HLR)
        - •• Visited Location Register (VLR)
    - Metro Packet Switch (MPS)
    - Mobile Switching Center (MSC)
        - •• Home Location Register (HLR)
        - •• Visited Location Register (VLR)
    - Subscriber Equipment
    - Operations and Management Center (OMC)

- This section will also highlight the manner in which Nextel's primary services are processed
    - Digital cellular interconnect
    - Direct Connect dispatch
    - Alphanumeric text messaging

NEXTEL INFRASTURCTURE ELEMENTS

Source: Motorola

A-1F

THE BASIC ELEMENT OF THE NEXTEL NETWORK IS THE ENHANCED BASE TRANSCEIVER SYSTEM (EBTS) CELL SITE

- The EBTS provides the interface between mobile subscriber radios and the network equipment
  - The EBTS consists of one or more base radios, a local site controller, a radio distribution system, a frequency reference, a site synchronization receiver and antenna, a local area network (LAN) interface, and antennas
    - •• Each base radio performs the communication with the subscriber units, sending both control and compressed speech using TDMA technology
    - •• Each base radio handles one 25 KHz channel
    - •• Up to six dispatch conversations per frequency can occur simultaneously

- EBTS are configured in a cellular-like manner to enable the reuse of frequency
  - EBTS coverage areas typically vary between 1–10 miles
  - EBTS cell sites are typically configured as an omni or three-sectored site to fulfill the coverage plans of the system
    - •• Omni site configurations may include as many as 20 channels, yielding up to 120 timeslots
    - •• Sectored sites may accommodate up to 24 channels, yielding up to 144 timeslots

- The EBTS provides much of the lower level site control functions, which minimizes the number of messages sent to other infrastructure elements

- The EBTS measures call control parameters such as handover measurement request parameters

- Interconnection between the EBTS sites and other network equipment is provided through leased T1's
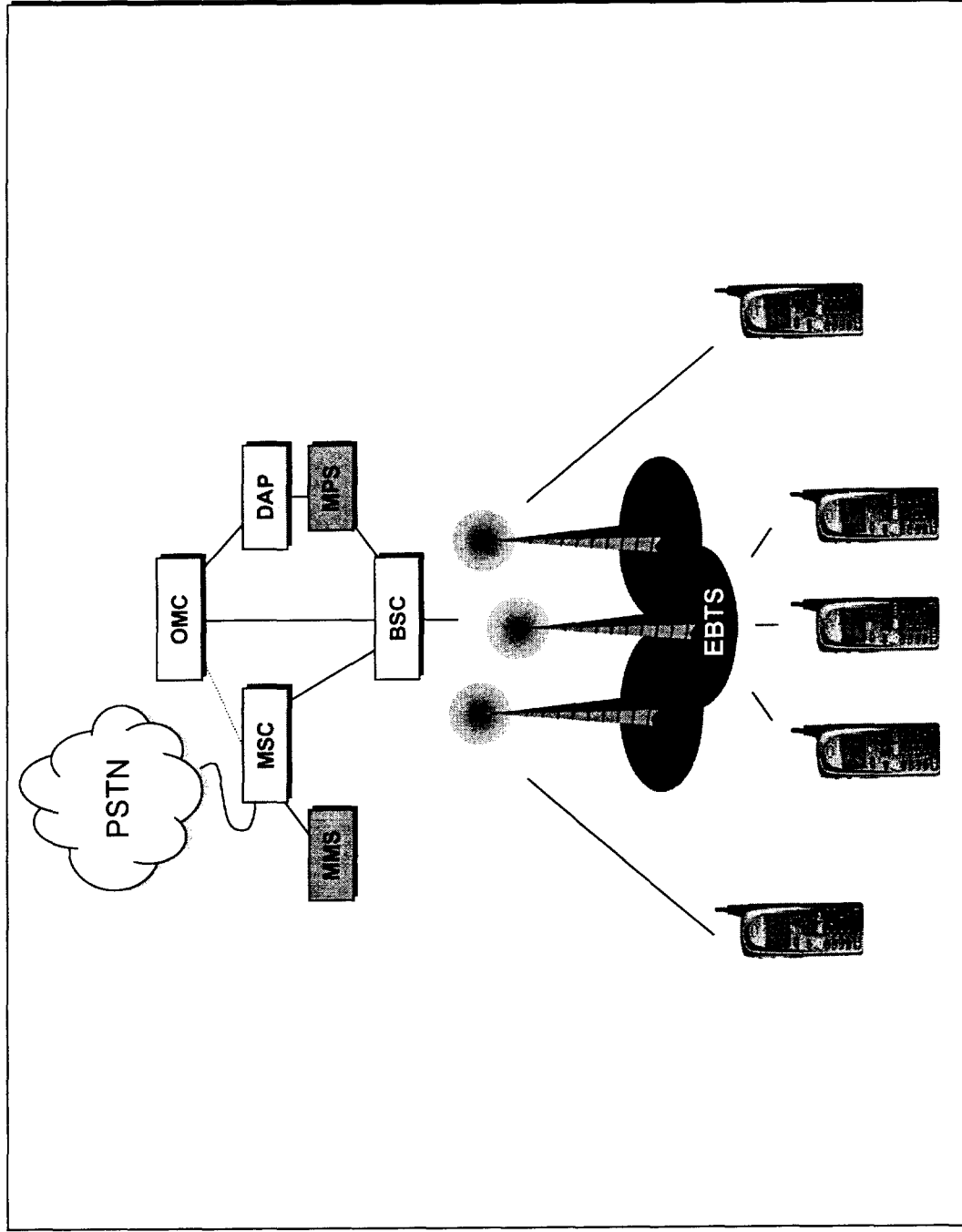
NEXTEL INFRASTURCTURE ELEMENTS

Source: Motorola

A-2F

THE BASE SITE CONTROLLER (BSC) IS THE CONTROL AND SWITCH INTERFACE FOR ALL NEXTEL SERVICES

- The BSC provides control and concentration functions for one or more EBTS sites
    - Allocates voice traffic and control channels
    - Serves as a concentration point for up to 80 EBTS sites or 1600 base radios
    - Performs handovers between multiple EBTS under its control
    - Provides a concentration point for the operations and network management system

- Each time a Nextel subscriber places an interconnect, dispatch, or text message communication, the transmission is sent through the BSC
    - Switches EBTS sites to mobile switching center for cellular calls
    - Switches EBTS sites to dispatch application processor/metro packet switch for direct connect calls

- The BSC and mobile switching center are connected by redundant 24 channel leased T1's

- The BSC exchanges signaling information with the MSC through an "A" interface based on GSM that has been modified to support iDEN radio requirements; this includes changes in message formatting and inclusion of additional parameters for handover messaging

NEXTEL INFRASTURCTURE ELEMENTS

A-3F

DISPATCH APPLICATION PROCESSORS AND METRO PACKET SWITCHES ARE RESPONSIBLE FOR THE OPERATION OF DIRECT CONNECT DISPATCH COMMUNICATIONS

- The Dispatch Application Processor coordinates and controls the Direct Connect dispatch service
  - Processes Private, Group, and Alert Calls
  - Contains subscriber data on individual fleet and unit information, dispatch and ID features, subscriber talkgroup information, and a unit's calling privileges

- The DAP also registers and deactivates subscriber units
  - Provides over-the-air subscriber configuration (system parameters)
  - Provides auto-registration
  - Provides push-to-talk ID

- When a subscriber unit is turned on, its identification and location are automatically registered at the DAP and tracked until the unit is turned off

- The DAP conserves radio frequency (RF) resources by selectively illuminating only those EBTS sites where there are subscribers in a particular talkgroup

- The Nextel network has 15 DAPs nationwide

- The Metro Packet Switch (MPS) consists of a packet switch and packet duplicator and enables wide-area Direct Connect service
  - Replicates and distributes dispatch voice packets
  - Provides a concentration point for multiple BSCs
  - Provides traffic control allocation

- The MPS voice packet protocol is based on frame relay technology

NEXTEL INFRASTURCTURE ELEMENTS
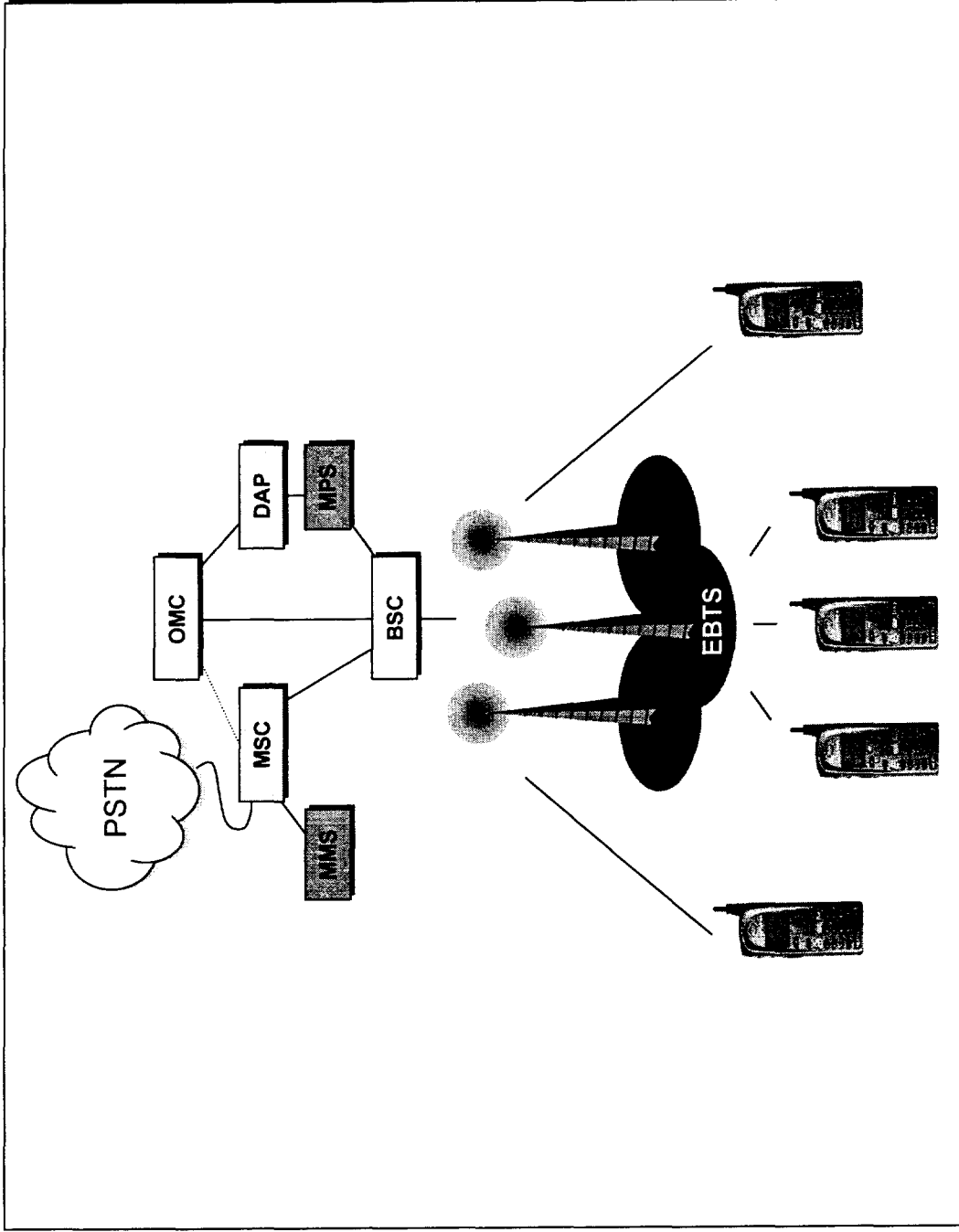
A-4F

Source: Motorola

THE MOBILE SWITCHING CENTER (MSC) PROVIDES THE INTERFACE BETWEEN THE NEXTEL NETWORK AND THE PUBLIC SWITCHED TELEPHONE NETWORK

- A Nortel digital multiplex switch provides a variety of services to Nextel users within a certain geographic coverage area at the MSC
  - Authentication of subscriber units
  - Processes all cellular calls
  - Provisions supplementary subscriber services and features
  - Controls call setup and routing procedures
  - Collects and routes billing and statistical information
  - Controls handoffs between EBTS controlled by different BSCs
  - Controls roaming between MSCs

- Messages between MSCs rely on a proprietary Motorola protocol not the cellular IS-41 protocol

- The MSC and BSC are linked by T1 facilities using mu-law protocol

- Nextel has 22 Nortel DMS switches serving as MSCs and plans to have 35 installed by the end of 1998

- A Message Mail Service (MMS) is attached to the MSC and encompasses all the hardware and software required to store and deliver alphanumeric text messages

NEXTEL INFRASTURCTURE ELEMENTS

Source: Motorola

A-5F
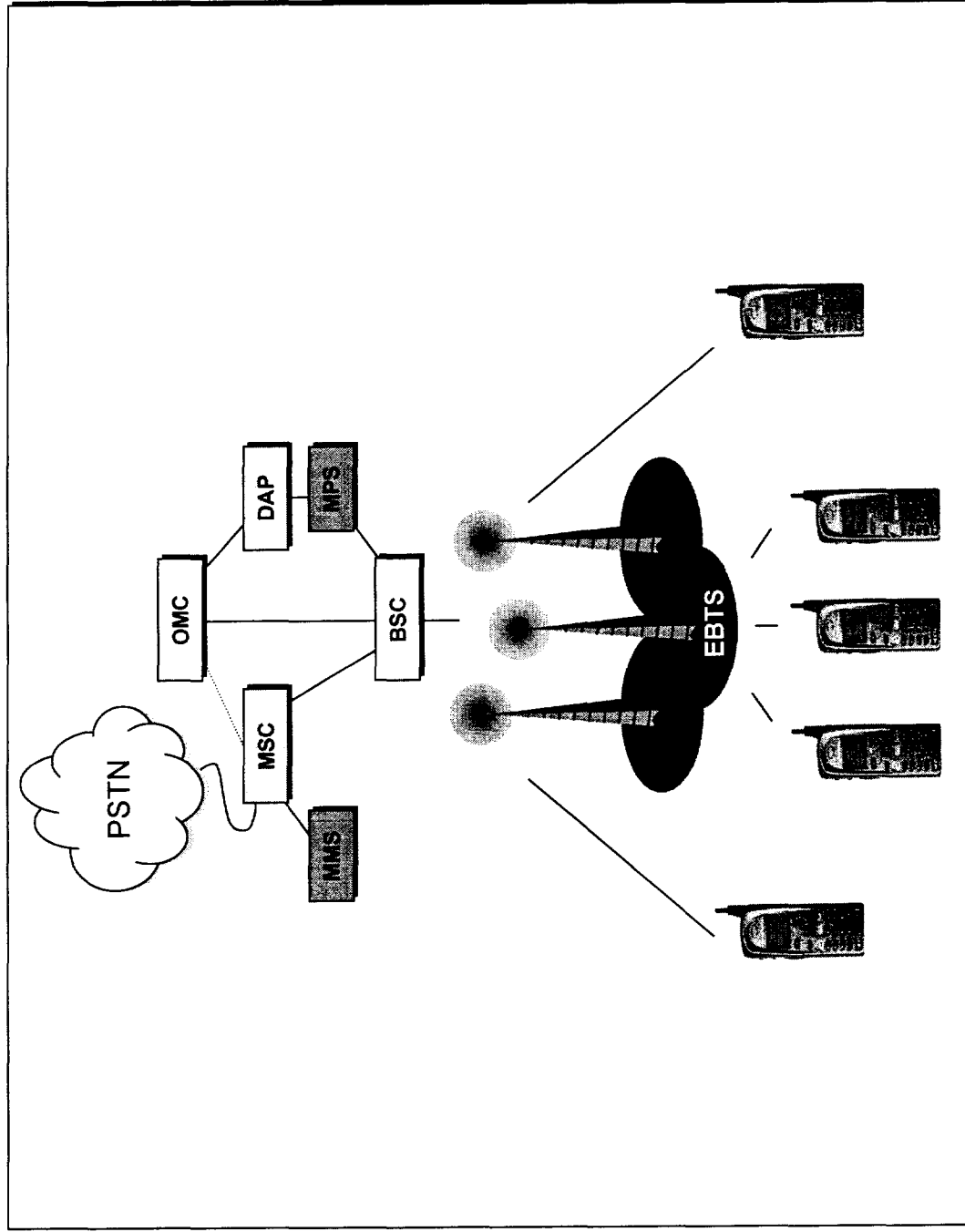
HOME LOCATION AND VISITED LOCATION REGISTERS LOCATED AT THE DAP AND MSC TRACK AND VALIDATE NEXTEL USERS

- The DAP home location registers (D-HLR) are databases residing in the DAP that store information on dispatch access rights and features specific to each phone
  - Perform subscriber access control and is queried each time a dispatch call is initiated
  - Manage access to the system by verifying requests for service against a database of subscriber privileges

- The MSC home location register (M-HLR) store every phone's permanent subscriber interconnect record
  - Phone IDs and various telephone supplementary services are provisioned in the M-HLR
  - Performs subscriber access control
  - Queried each time an interconnect call is initiated or call feature is requested

- The Visited Location Registers are fast access RAM databases at the MSCs and DAPs that contain real-time information on each subscriber unit (i.e., location within the system) as well as feature provisioning information found in the HLRs

NEXTEL PHONES ARE INCOMPATIBLE WITH ANY OTHER WIRELESS NETWORK AND FOLLOW A REGISTRATION PROCESS EACH TIME THEY ARE POWERED-ON OR MOVE FROM ONE EBTS SITE TO ANOTHER

- When phones are shipped from the Motorola factory, they do not require programming by Nextel or a dealer
  - System access is denied until arrangements are made with Nextel to authorize the phone on the network
  - Each phone has a version of code software, a control channel band map, and an International Mobile Equipment Identifier (IMEI)
  - The IMEI and its associated configuration parameters must be entered into the MSC and DAP HLRs before the phone can access the network

- A phone will attempt to register with the system when it is first turned on
  - During this registration attempt, the phone sends the IMEI to the D-HLR and M-HLR and then an International Mobile Subscriber Identity (IMSI) that uniquely identifies the unit on the system is assigned, the operating parameters are downloaded, and access to the network is allowed
  - The IMSI is also sent to the VLR
  - The IMEI is used in this initial system access request only and never again

- Phones are registered in a different manner subsequent to the initial registration
  - After a unit is powered on it sends its IMSI to the MSC HLR which issues and sends a temporary mobile station identifier (TMSI) to the phone
  - The TMSI is also sent to the VLR
  - The TMSI may be changed between calls or even during a call to preserve subscriber confidentiality

## NEXTEL'S ENTIRE NETWORK IS MANAGED AT THE OPERATIONS AND MANAGEMENT CENTER IN MCLEAN, VIRGINIA

- The OMC is connected to other system elements through a X.25 packet network

- The OMC supports several key functions
    - Configuration management (i.e., software loads, databases maintenance, and component status monitoring)
    - Fault management (e.g., diagnostics and loop-back tests)
    - Performance management (i.e., collection and synthesis of metrics)
    - Security management
    - Event/alarm management

- System reports are generated and system performance can be measure at the OMC

NEXTEL DIGITAL INTERCONNECT CALLS ARE PROCESSED SIMILAR TO OTHER WIRELESS SERVICE CALLS

- All outgoing Nextel telephone interconnect calls are processed by the service area's MSC
  - A Nextel subscriber dials a telephone number
  - The call request is sent via control channel to the nearest EBTS
  - The EBTS sends control information and call content to the BSC
  - The MSC processes the authentication procedure (if necessary), processes dialed digits, communicates with the PSTN (for landline calls only), and provides call routing instructions and a radio channel pair to the BSC and mobile station
  - Assuming authentication and landline call completion, the MSC sends a connecting message to the subscriber unit

- Incoming interconnect calls are also handled by the MSC
  - The MSC processes an incoming call from the PSTN by searching for the last known location of the called mobile and then sending a page to the BSC in that area
  - If the mobile station is powered on, it acknowledges the page via the control channel and requests a radio channel
  - The MSC provides routing instructions and a radio channel pair to the BSC and called subscriber (subscriber-to-subscriber calls are directly connected between BSCs)
  - The MSC connects the call through to the mobile station for ring alerting; upon call answer, the voice connection is established
  - If busy, the calling party is sent a busy tone
  - If no answer, the call is terminated with a no answer message unless alternative call answering is applicable (voice mail or call forwarding)

CALL PROCESSING SCHEME FOR NEXTEL CELLULAR CALL

PSTN

To another MSC

MSC

DAP

BSC

BSC

EBTS

EBTS

A-9F
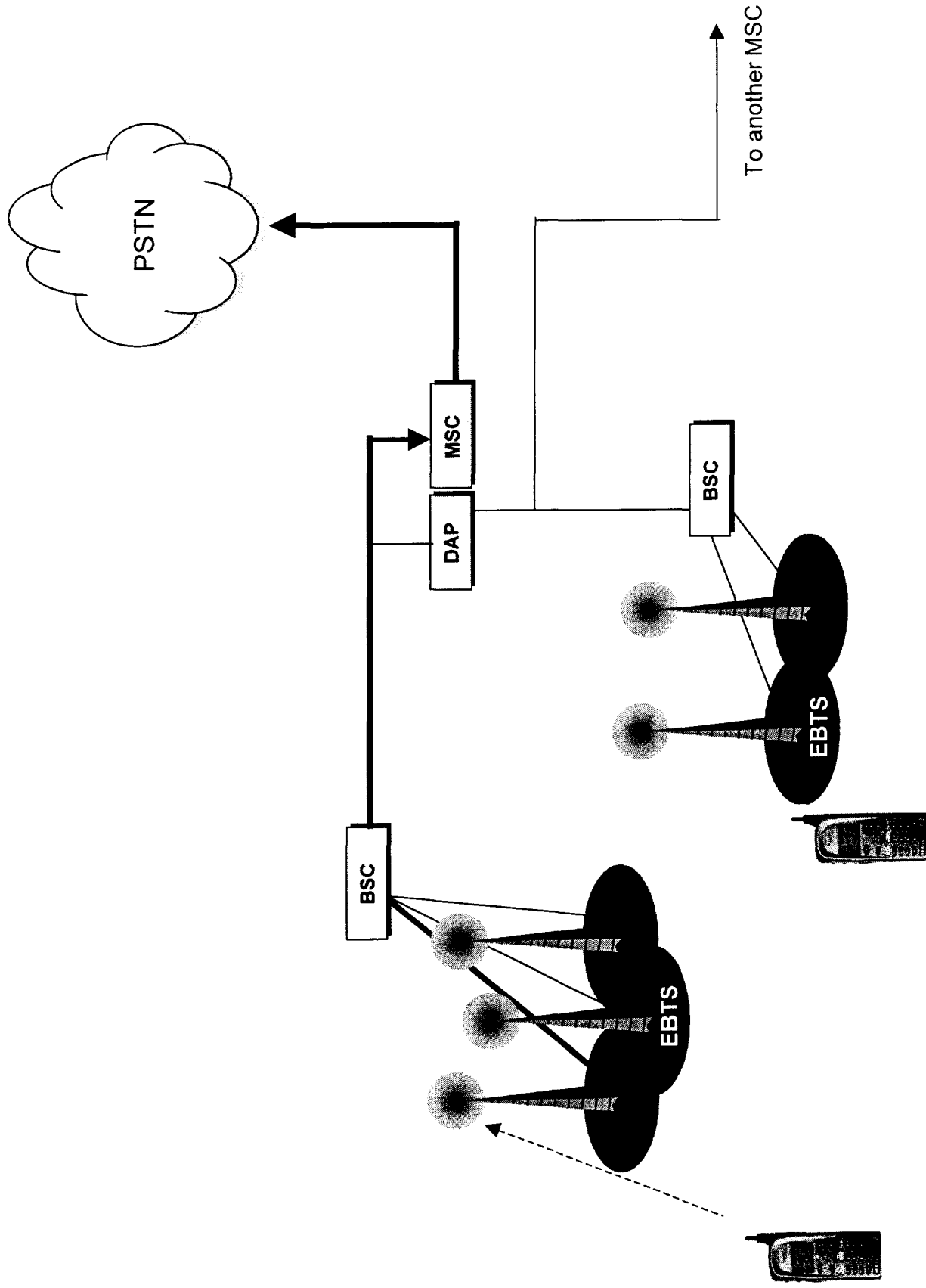
A DIRECT CONNECT DISPATCH CALL IS INITIATED WHEN A USER PUSHES THE PTT BUTTON FOR A PRIVATE OR GROUP CALL

- Dispatch call requests are immediately routed by the EBTS to the DAP

- The DAP determines and validates the caller's talk group during group call requests and identifies the locations of the group mobiles (if needed, the DAP sends a base station location request for the location area of each mobile station in the talk group)

- The DAP provides the requesting EBTS with a radio channel and routing information for the caller's voice packets – the DAP also provides radio channels for the destination EBTS and mobile stations in the talk group

- If a radio channel is not available at the EBTS of one or more other talk group members, those members are included in the call when a channel becomes available at their serving EBTS

- The iDEN system employs a hang timer that allows a subscriber to continue a Direct Connect conversation without the need to set up another channel
    - Dispatch users typically learn the habit of releasing the PTT microphone button at the end of each spoken phrase to await a response
    - If the conversation continues, it will usually occur within several seconds
    - The hang timer can be adjusted by a system operator to reduce the average traffic intensity

CALL PROCESSING SCHEME FOR DIRECT CONNECT PRIVATE CALL

A-10F
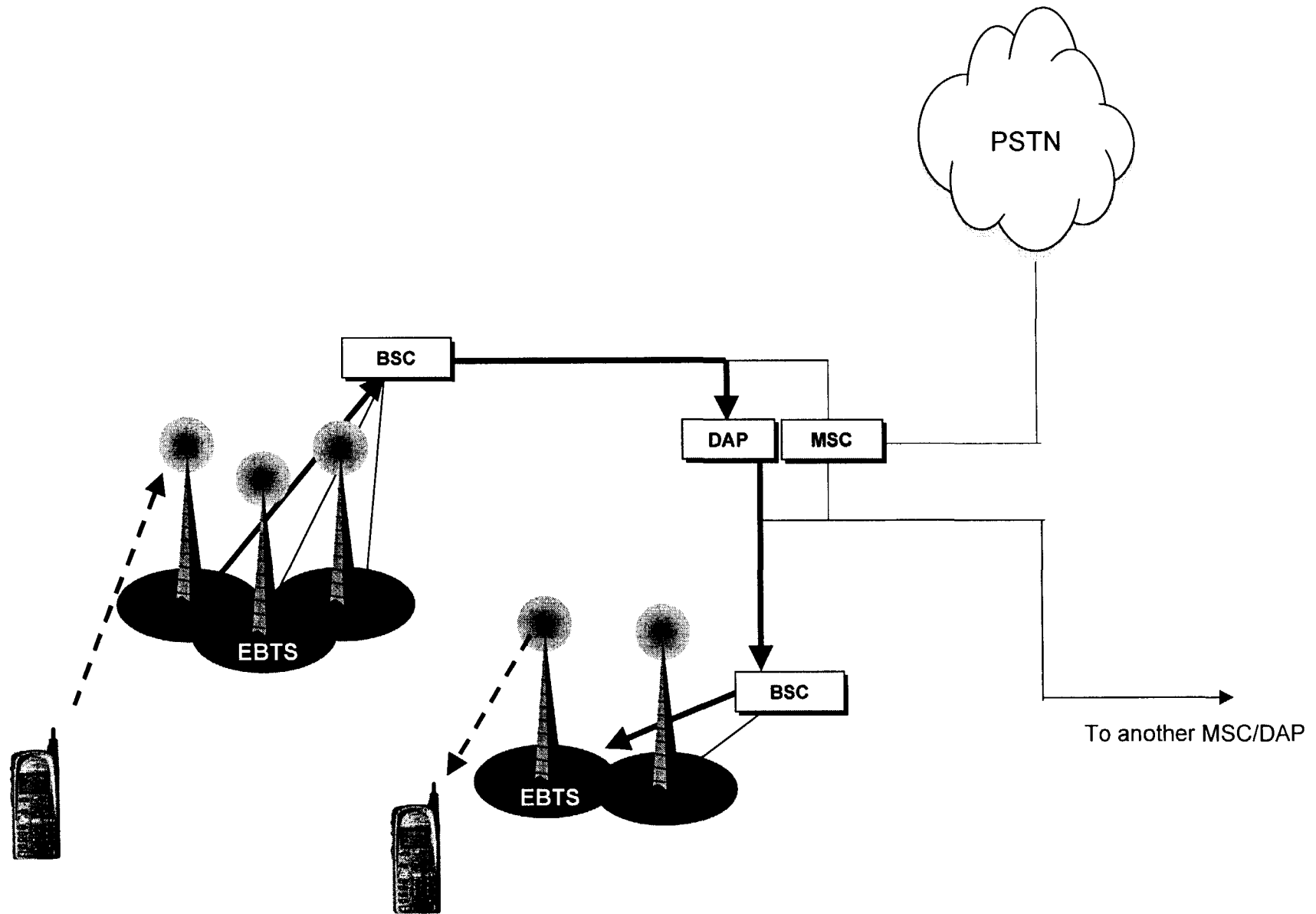
TEXT MESSAGING AND ALPHANUMERIC PAGING IS PROVISIONED IN THE IDEN NETWORK THROUGH THE MESSAGE MAIL SYSTEM

- Text messages generated by software on the Internet, dual-tone multifrequency (DTMF) dialed digits within the MSC, or voice mail notification stored in a home location register are processed and forwarded by the MMS to the MSC

- If a message is waiting or stored for the mobile and the mobile is idle (powered on but not in use) or on an interconnect call, the MMS will deliver the message to the MSC through interface software

- The MSC routes the message data to the BSC and EBTS where the radio is located for delivery over the control channel to the radio

- A feature of iDEN or cellular/PCS based messaging is the handset's ability to acknowledge receipt of messages by transmitting an acknowledgment signal via the EBTS back to the MSC and MMS

- The network also allows radios to generate and transmit messages to the MSS over the control channel for forwarding to other mobiles and networks via the BSC and MSC

CALL PROCESSING SCHEME FOR ALPHANUMERIC MESSAGE

A-11F